VEHICLE ENGINEERING

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

ORBITER	**To Be Presented**
SOFTWARE	**No Constraints**
FCE	**No Constraints**
GFE	**To Be Presented**
BACKUP INFORMATION	

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

STS-106
FLIGHT READINESS REVIEW

August 29, 2000

Orbiter

AGENDA

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

- Engineering Readiness Assessment
  - Previous Flight Anomalies — To Be Presented
  - Critical Process Changes — To Be Presented
  - Engineering Requirement Changes — No Constraints
  - Configuration Changes and Certification Status — To Be Presented
  - Mission Kit Status — No Constraints
  - Safety, Reliability and Quality Assessment — No Constraints
- Special Topics — To Be Presented
  - MEDS IDP MSU Failure
  - OMS Engine Transducer Gaps
  - MPS LH2 Manifold Bellows Repair
  - Potential Contamination of MPS GO2 Pressurization System
  - LO2 Prepress Disconnect Damage

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

PREVIOUS FLIGHT ANOMALIES

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

STS-101
IN-FLIGHT ANOMALIES

PREVIOUS IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

STS-101 In-Flight Anomalies (Previous Mission):

- 6 problems identified
  - STS-101-V-01: LOME Bipropellant Valve 2 Indicates Open
  - STS-101-V-02: LOME GN_2 Regulator Pressure Low During Post-Burn Purges
  - STS-101-V-03: Ku-Band Radiating Within the RF Protect Box
  - STS-101-V-04: PRSD O_2 Tank 4 A Heater Temporarily Failed
  - STS-101-V-05: Collins TACAN BITE Faults
  - STS-101-V-06: Slumped Tile at the Wing Leading Edge with Internal Flow

All IFAs were reviewed and none constrain the STS-106 flight

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-01: LOME Bipropellant Valve Indication Failed Open

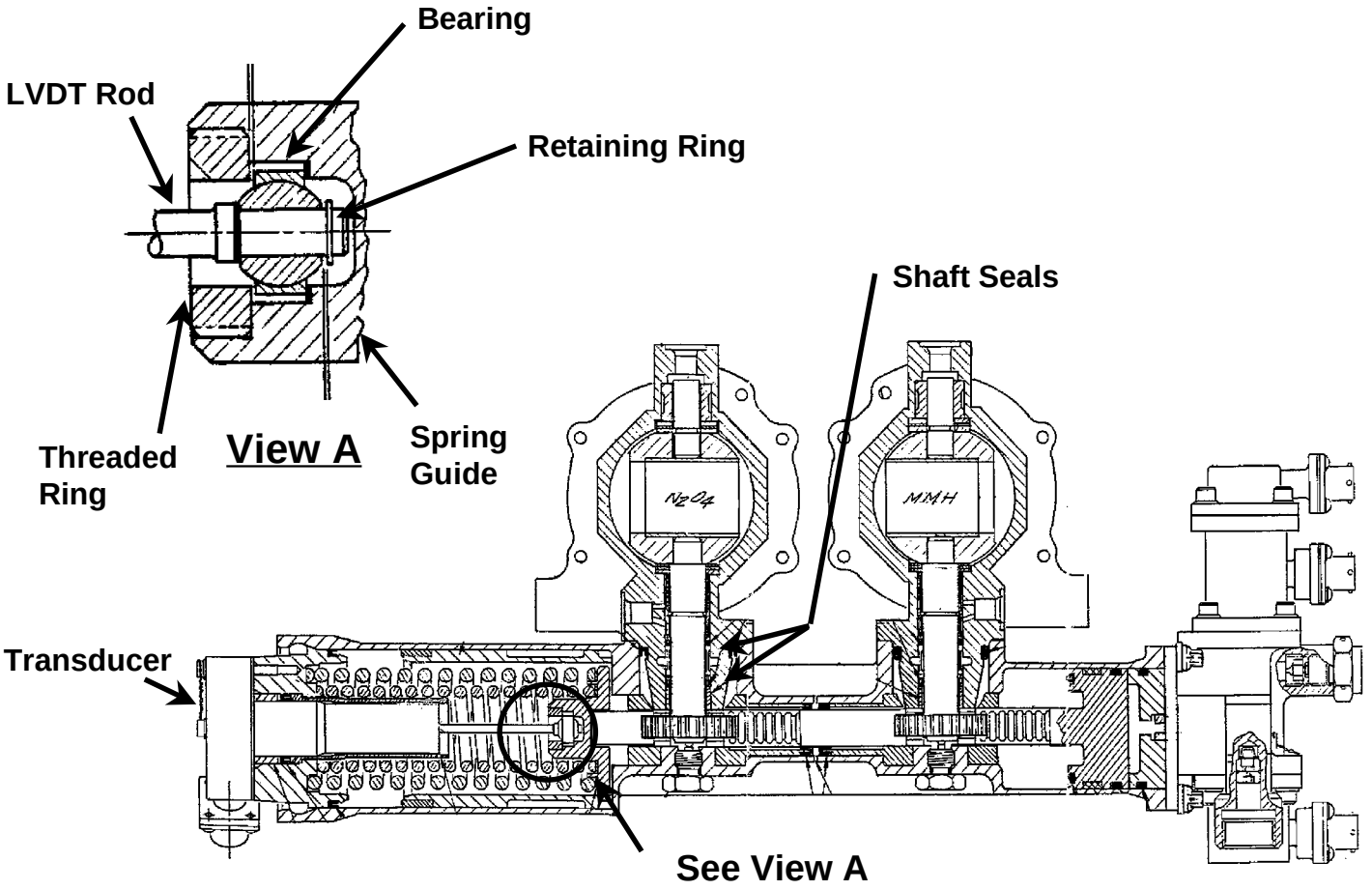
- Following the STS-101 OMS-3 burn, the left OMS engine (S/N 111) bipropellant valve (BPV) #2 position indicated failed open
- Post-flight troubleshooting isolated the problem to the linear variable differential transducer (LVDT) which provides the valve position indication
- Confirmed the failure was instrumentation only
- LVDT #2 was R&R'd and failed LVDT was returned to WSTF for TT&E
  - TT&E determined LVDT rod was stuck in transducer and retaining "C" clip had come off end of rod in spring guide
  - Formation of contamination on LVDT rod, formed as a result of oxidizer permeation beyond valve shaft seals, restricts movement of rod enough to overcome the capability of the retaining clip

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Bipropellant Valve with LVDT Rod End Detail



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PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-01: LOME Bipropellant Valve Indication Failed Open

- Determined corrective action for LVDTs remaining in the fleet which have the highest potential for contamination
  - OV-102 LOME LVDTs will be replaced prior to flight (STS-107)
  - OV-103 LOME LVDT #2 will be replaced during next flow (STS-102)
  - OV-104 LOME LVDT #1 will be replaced next flow (STS-98)
  - All remaining LVDTs are acceptable
- Acceptable for STS-106 Flight
  - New LVDT, spring guide, and springs installed in bipropellant valve #2 – OMRS retest within spec
  - Failure is visible and manageable in flight
    - Flight rules allow use of engine with failed open indication for deorbit burn
  - Subsystem redundancy exists - two OMS engines and four +X RCS thrusters

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-02: LOME GN_2 Regulator Pressure Low During Post-Burn Purges

- During the OMS assist start transient, post burn purge, and the OMS 2 post burn purge, the LOME GN_2 regulator pressure indicated 296, 295 and 297 respectively (FDA limit is 299 PSIA)
- FDA alarms were generated; however, there was no mission impact
- Upon completion of the start transients and purges, the regulated pressure returned quickly to a nominal value of 312 PSIA
- During post-flight safing operations at KSC, OMS engine GN_2 vent was performed
  - Regulator performance was nominal
- Previous flight data for this regulator shows similar low transient pressures

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-02: LOME GN_2 Regulator Pressure Low During Post-Burn Purges (Cont)

- PRT decided to R&R regulator to avoid FDA alarms and to perform TT&E on the regulator at the vendor

- Acceptable for STS-106 Flight
  - Regulator was R&R'd and retested per OMRS

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

STS-101-V-03: Ku-Band Radiated in the RF Protect Box

- During Orbiter/ISS docked operations, on two occasions, the Ku-Band Traveling Wave Tube (TWT) radiated into the RF protect box
  - RF protect box is designed to protect EVA Crew and ISS equipment (Node, FGB, Solar Arrays)
- Each occurrence was approximately 2 seconds in duration and took place when the antenna was driving from TDRS east to TDRS west
  - Problem determined to be result of time lag (maximum 2.8 seconds) between antenna pointing into RF protect box and GPC output of TWT inhibit command
- Data review showed that similar problem occurred during the STS-103 mission
- SM Antenna Management software requirements were found to not fully account for the TDRS handover scenario and associated high antenna rates
  - Software coded per requirements

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-03: Ku-Band Radiating within the RF Protect Box (Cont)

- Ku-Band hardware performed nominally
- During the remainder of the mission, to prevent re-occurrences, ground controllers turned the TWT off when the TDRS was predicted to be within the box at AOS
  - Uplink a stored command to inhibit TWT
  - Uplink a command to enable TWT after pointing angles are outside the protect box
- In parallel, the long-term resolution is currently being formulated by the technical community

- Acceptable for STS-106 Flight:
  - A procedure similar to that used on STS-101 will be used on STS-106 if the TDRS is predicted to be within the box at AOS

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-04: O_2 Tank 4 Heater A Failed to Activate

- During flight day 2 post sleep cryo reconfiguration, the O_2 tank 4 A and B heaters were placed in AUTO (panel A11)
  - Following the first cycle (which was nominal), the A heater did not come on during subsequent cycles
  - The A heater switch was cycled to the OFF position and then back to the AUTO position
  - Both A and B heaters cycled and the functionality of the heater was regained
  - Heater performed nominally the remainder of the mission including during several switch throws
- During post-flight troubleshooting, attempted to recreate anomaly by manipulating panel A11 switch - no repeat
- Checked cryo control box connections and found no discrepancies

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-04: O_2 Tank 4 Heater Failed to Activate (Cont)

- Most probable cause is intermittent loss of signal to or from either of two hybrid drivers in cryo control box #4 resulting in loss of power to the A heater assembly
- Problem could exist anywhere in the path from D&C panel A11 O_2 tank 4 heater A switch, through wire harnesses and connectors to the cryo controller # 4 connector J7

- Acceptable for STS-106 Flight:
  - Loss of a single heater is crit 2R3 and has no impact to the mission
  - Redundant heater can be used to pressurize the tank

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-05: Collins TACAN BITE Faults

- Prior to acquiring the ground station during STS-101 entry, Collins TACAN #3 (S/N 006) exhibited two BITE faults due to low RF output power
  - Following acquisition at ~350 Nmi, the TACAN tracked normally through landing and rollout
- The TACAN was R&R'd and TT&E was performed
  - RF output power was below specification (measured 560 watts, should be 800 watts minimum)
  - The cause was isolated to a failed transistor in the power amplifier of the RF module
- Failure history investigation revealed four previous transistor failures were found during vendor testing in the mid-90s
  - Cause was not isolated, but most likely was improper termination of an antenna port

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-05: Collins TACAN BITE Faults (cont)

- STS-101 OMRS test output power for TACAN #3 measured 566 watts vs. 500 watt OMRS requirement
  - 300 watt difference between OMRS test requirement vs. specification is to allow for potential losses through the RF cable, antenna and hat coupler
- STS-101 TACAN #1 OMRS test measured 683 watts
  - Met the OMRS requirement, but also below specification output power
  - Range acquisition will be nominal since GN&C range acquisition requirement of 160 to 200 Nmi is achieved with output power as low as 200 watts
  - In-flight BITE fault is not expected since output power measured greater than TACAN S/N 06
- OMRS measured output power for both TACAN #2 and replacement TACAN #3 met specification requirement

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

STS-101-V-05: Collins TACAN BITE Faults (cont)

- Actions In-work/Planned:
  - TACAN OMRSD power output test requirement and procedures will be reevaluated
  - Direct measurement of TACAN #1 output power will be performed after STS-106 to determine if RF output is below specification
    - TACAN will be R&R'd if specification not met
- Risk Assessment:
  - This failure mode is criticality 1R3
  - LCC requires 2 of 3 operational TACANs
  - Even with an additional RF transistor failure, the TACAN will meet the minimum GN&C range acquisition requirement of 160-200 Nmi
  - Failure of an RF transistor will not affect the rest of the electronics/unit

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

STS-101-V-05: Collins TACAN BITE Faults (cont)

- Risk Assessment (cont):
  - In the worst-case event of loss of RF output power:
    - Range data for the affected TACAN would be lost
      - Indicated as an “M” (missing) to the crew via the horizontal situation display (HSD)
    - BITE fault would occur
    - Bearing data would not be affected
    - GN&C software would use average range of the other two TACANs
- Acceptable for STS-106 flight:
  - Failed TACAN #3 S/N 06 was removed and replaced with S/N 09 which met specification requirement
  - Though TACAN #1 output power may be below specification, range acquisition will be nominal
    - In-flight BITE fault is not expected

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

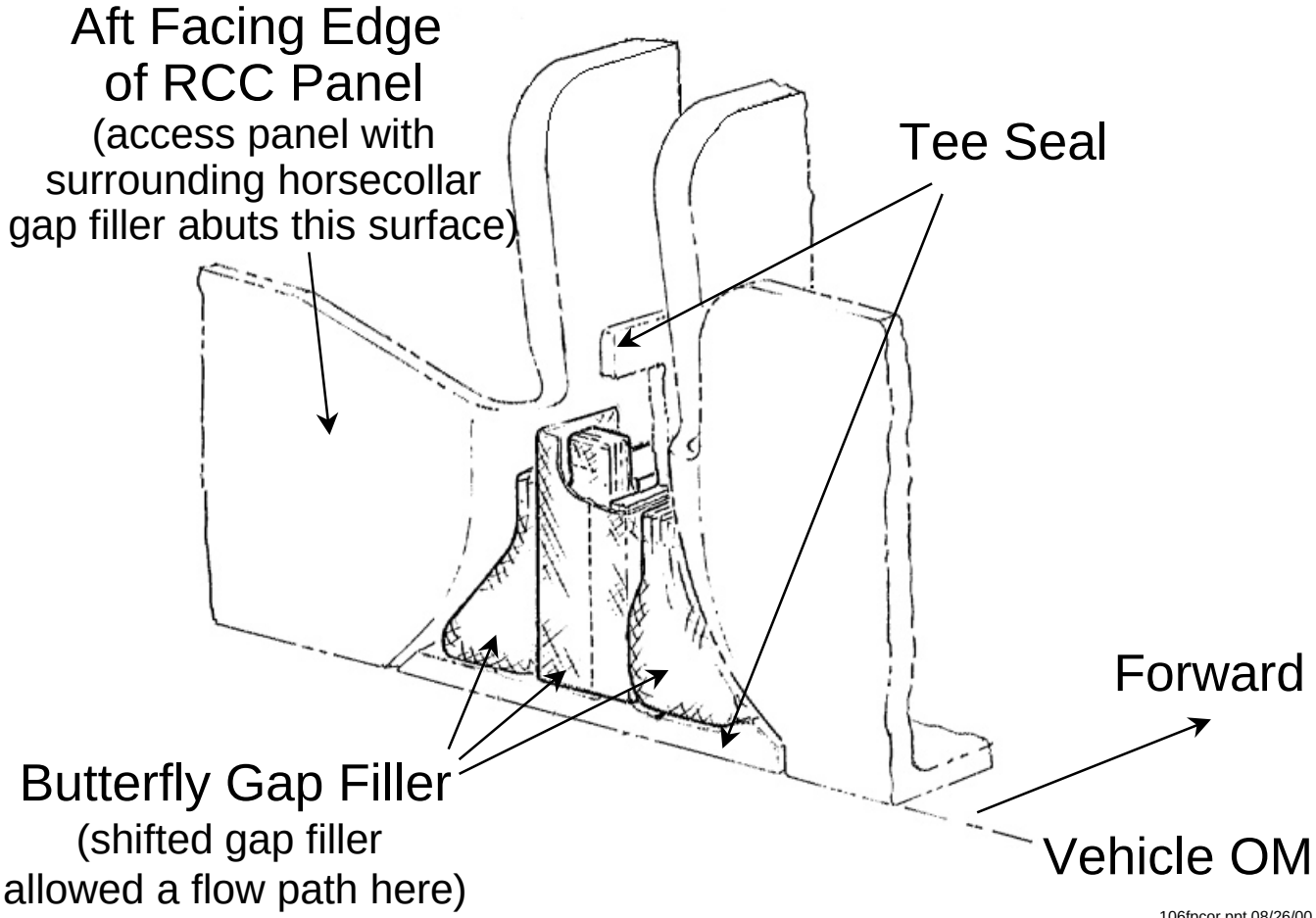
STS-101-V-06: Slumped Tile at Wing Leading Edge

- Post landing inspection of OV-104 following STS-101 revealed a slumped leading edge access panel tile adjacent to the wing leading edge reinforced carbon carbon (RCC) structure
- Immediately aft of the wing leading edge RCC, leading edge access panels are installed to provide installation/removal access to the RCC attach fittings
- A horsecollar gap filler surrounds each leading edge access panel and performs the primary sealing function between the RCC panel and the access panel tiles
- Small gaps around the end of RCC Tee seals are filled by butterfly gap fillers

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-06: Slumped Tile at Wing Leading Edge



PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

STS-101-V-06: Slumped Tile at Wing Leading Edge

- Disassembly revealed the butterfly gap fillers adjacent to the RCC T-Seal had shifted during installation
- The horsecollar and butterfly gap fillers were new parts installed at OMM
- During LE access panel installation, pull loops are attached to the butterfly gap fillers
  - Function of the pull loops is to provide the ability to maintain gap filler position during LE access panel installation
- If the pull loops are allowed to slide up during installation, the butterfly gap fillers will shift position
- Post-installation flow path inspection did not detect incorrect butterfly installation because the butterfly is more inboard of the OML than the horsecollar

PREVIOUS OV-104 MISSION STS-101 IN-FLIGHT ANOMALIES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

STS-101-V-06: Slumped Tile at Wing Leading Edge

- Corrective actions were implemented including a requirement to mark and maintain position of the butterfly gap filler pull loop during access panel installation
- All affected parts from OV-104 were removed and inspected
  - Inspection showed all RCC hardware to be acceptable for continued use
  - Damaged access panel tile and gap fillers were replaced
- RCC, leading edge access panels, tile and gap fillers were reinstalled per print following the revised pull loop procedure

- Acceptable for STS-106 Flight:
  - All affected parts were inspected and either accepted or replaced

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

OV-102 WIRE INSPECTION ASSESSMENT

OV-102 WIRE INSPECTION ASSESSMENT

Presenter: Doug White
Organization/Date: Orbiter/8-29-00

OV-102 Wire Inspection Purpose Was Two-Fold

- To locate, assess, and repair damaged wiring
- To validate the criteria used to perform the inspection and repair on the rest of the fleet

Both Objectives Have Been Accomplished

- OV-102 inspection and repair is complete and damage has been assessed
- No new types of damage have been discovered
  - Root cause remains mechanically induced damage
- Fleet-wide inspection and repair criteria has been validated
- Rationale for flight is still valid
  - Areas of significant damage on OV-102 were inspected and repaired on OV-104
  - If undetected damage exists, consequences of damage are mitigated by Orbiter design

OV-102 WIRE INSPECTION ASSESSMENT	Presenter: Doug White
	Organization/Date: Orbiter/8-29-00

OV-102 Wire Inspection Assessment

- Access to OV-102 wire harnesses for inspection was significantly greater than for any other vehicle in the fleet
  - Many LRUs removed to perform modifications
  - Majority of all convoluted tubing was removed for inspection under the tubing
  - 95% of all wire harnesses inspected
- Two major types of wire harness inspections performed at Palmdale
  - Category 1 — wire harnesses opened for modifications or to determine the extent or observed damage were fanned and each wire was inspected (~30%)
  - Category 2 — all other wire harnesses were completely inspected on the perimeter
  - Did not keep track of PRs (Kapton damage, exposed conductors, etc.) by category

OV-102 WIRE INSPECTION ASSESSMENT

Presenter: Doug White
Organization/Date: Orbiter/8-29-00

OV-102 Wire Inspection Assessment

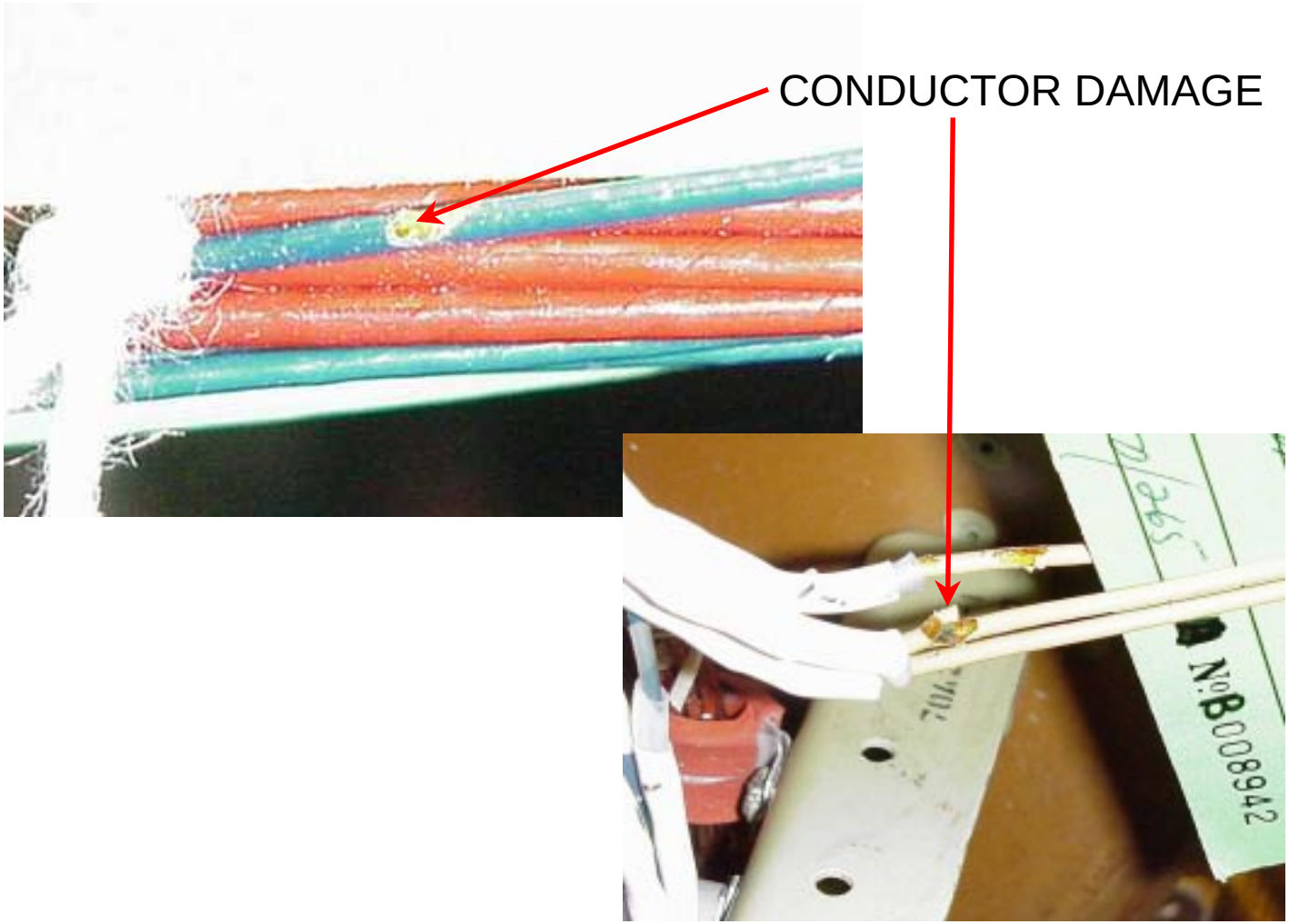
	OV-102	OV-103	OV-104	OV-105
Kapton/Other Damage				
Forward	449	31	38	24
Mid	514	136	343	144
Aft	354	227	398	89
Exposed/Damaged Conductors				
Forward	72	4	7	1
Mid	132	26	43	45
Aft	151	60	55	27
Vehicle Totals				
	1682	450	792	312

- Numerical differences reflect differences in inspection access between vehicles and differences in vehicle age and modification history

OV-102 WIRE INSPECTION ASSESSMENT

Presenter:
Doug White

Organization/Date:
Orbiter/8-29-00



OV-102 WIRE INSPECTION ASSESSMENT	Presenter: Doug White
	Organization/Date: Orbiter/8-29-00

OV-102 Wire Inspection Assessment

- Forward
  - 56% (290/521) of PR conditions and 70% of exposed/damaged conductors found in flight deck
    - 24 exposed conductors
    - 27 damaged conductors
  - ***None found in shorting proximity of other conductors or structures***
  - No new modes of damaged observed
  - No unique groupings found that would indicate a common cause for mechanically-induced damage
- Mid
  - No new modes of damaged observed
  - No unique groupings found that would indicate a common cause for mechanically-induced damage

OV-102 WIRE INSPECTION ASSESSMENT

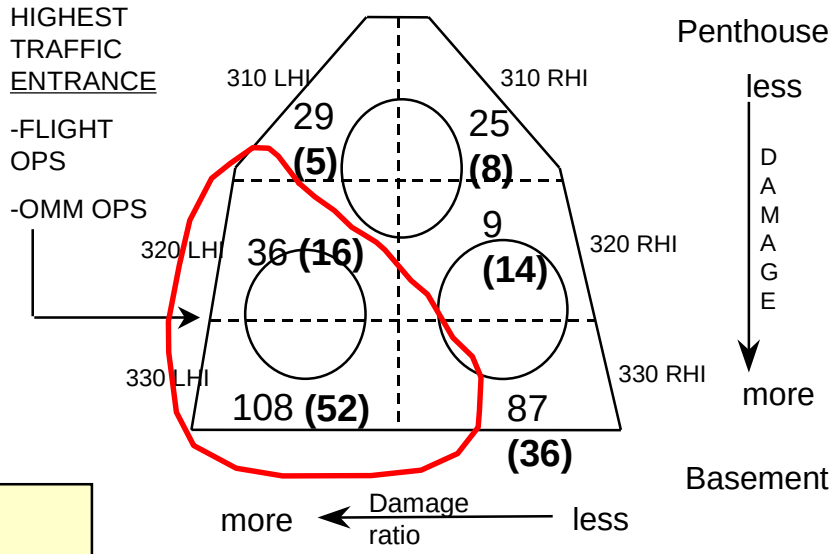
Presenter: Doug White

Organization/Date: Orbiter/8-29-00

Total Aft

Vehicle	Kap/Oth	Exp/Dam
102	364	151
103	227	60
104	398	55
105	89	27

AFT VIEW OF SHUTTLE ZONES



xx=Kapton and Other Damage

(xx) = Exposed and Damaged Conductor

Key trends noticed:

- Higher damage seen in high traffic areas
- Exposed/damage conductor in monoball connectors
- Risk of short with exposed conductor found near connector backshells

Aft Avionics Bays

Zone	Bay	Kap/Oth	Exp/Dam
321	4	31	5
322	5	15	2
331	6	21	13

OV-102 WIRE INSPECTION ASSESSMENT

Presenter:
Doug White

Organization/Date:
Orbiter/8-29-00

- Cursory inspection on 12 gage SRB-ORB-BUS wires located within ET monoball metal connectors. Radial cracks were found four inches from the main connector mate area within the 8-inch connector assembly
- ***Similar monoball area damage found and repaired in rest of fleet***

OV-102 WIRE INSPECTION ASSESSMENT	Presenter: Doug White
	Organization/Date: Orbiter/8-29-00

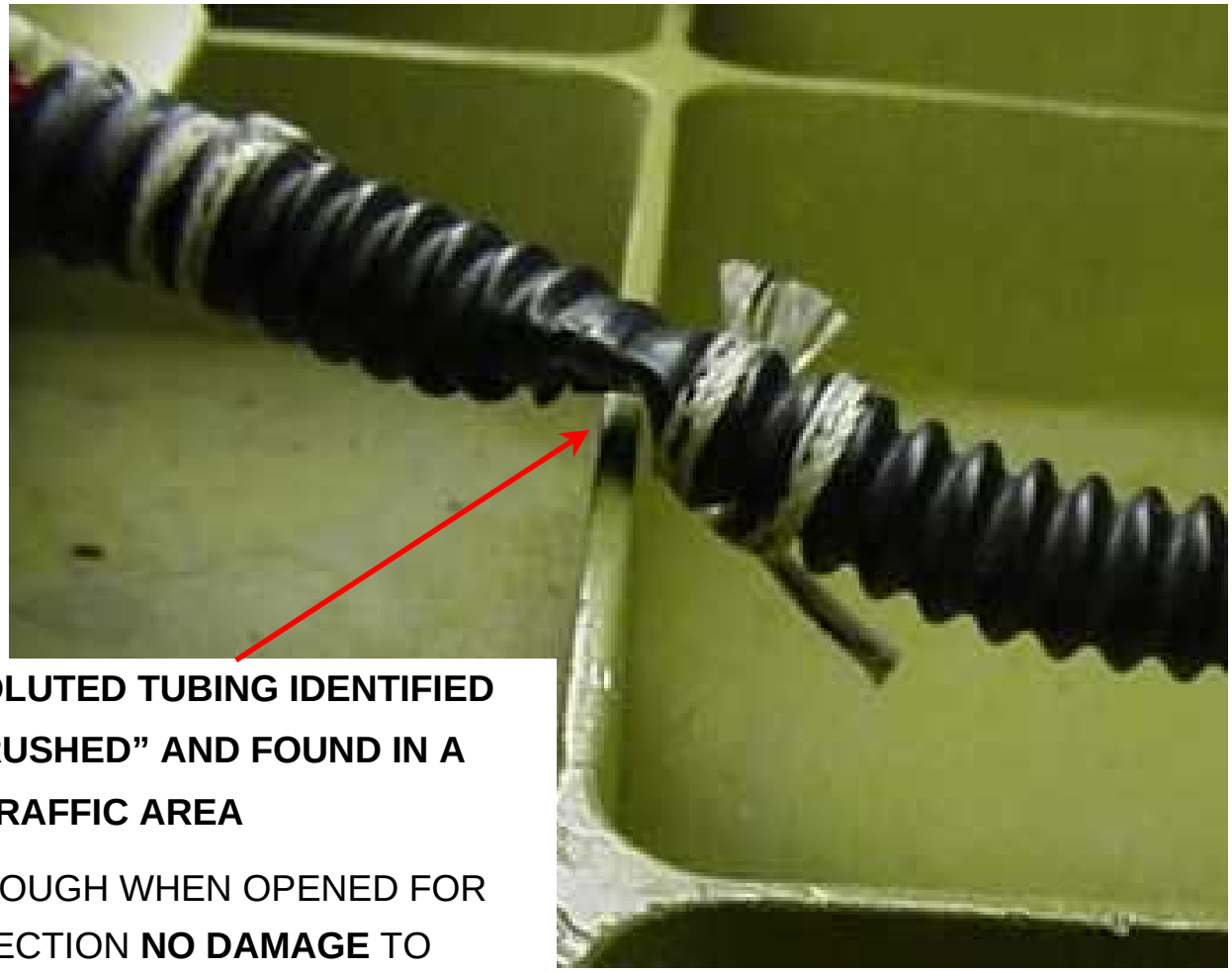
OV-102 Wire Inspection Assessment

- Damage under convoluted tubing falls into two types: “old” damage that existed when the tubing was applied, and “new” damage occurring since tubing installation
- The majority (80%) of new damage is found at the termination of the convoluted tubing
  - 32 exposed conductors in the aft were located between the end of the tubing and a clamp
  - 18 exposed conductors were located between the ends of the convoluted tubing and a connector
- The remaining (20%) new wiring damage was found under visibly damaged convoluted tubing
- These areas were inspected at KSC and any damage found was repaired

OV-102 WIRE INSPECTION ASSESSMENT

Presenter:
Doug White

Organization/Date:
Orbiter/8-29-00



CONVOLUTED TUBING IDENTIFIED AS "CRUSHED" AND FOUND IN A HIGH TRAFFIC AREA

- ALTHOUGH WHEN OPENED FOR INSPECTION **NO DAMAGE** TO WIRING WAS DISCOVERED

OV-102 WIRE INSPECTION ASSESSMENT	Presenter: Doug White
	Organization/Date: Orbiter/8-29-00

OV-102 Wire Inspection Observations and Conclusions

- Root cause of mechanically induced damage remains the same
  - No new failure mechanisms found
- Expect to find similar numbers of PRs for all vehicles during their OMM inspections
  - Larger number of PRs on OV-102 reflect differences in inspection access between vehicles and differences in vehicle age and modification history
- No exposed conductors found in proximity to any other exposed conductors
- No unique groupings found in forward or mid that would indicate a common cause for mechanically-induced damage

OV-102 WIRE INSPECTION ASSESSMENT

Presenter:
Doug White

Organization/Date:
Orbiter/8-29-00

OV-102 Wire Inspection Observations and Conclusions

- Damage pattern in the aft confirms that more damage is induced in higher-traffic areas
  - Higher number of PRs found in higher traffic areas
- Significant damage groupings in the aft were inspected and repaired on other vehicles
  - Exposed conductors between the ends of convoluted tubing and clamps or connectors
  - Exposed conductors in the backshells of the monoball connectors
  - Exposed conductors near connector backshells

OV-102 WIRE INSPECTION ASSESSMENT

Presenter:
Doug White

Organization/Date:
Orbiter/8-29-00

On-Going, Fleet-Wide Orbiter Wiring Improvement Plan Comprises Three Interlocking Areas

- Requirements
- Inspection
- Modifications

Requirements

- Inspection requirements baselined in OMRSD
- Inspection, repair, and protection requirements baselined in wire specification
  - Complete the in-work update of wire specification to include wrapping of wire bundles where they exit from convoluted tubing

OV-102 WIRE INSPECTION ASSESSMENT

Presenter: Doug White

Organization/Date: Orbiter/8-29-00

Inspection

- All inspection, repair, and protection (past and future) done per revised wire specification
- Personnel are trained and certified
  - Wire inspectors
  - All persons entering the Orbiter are trained for wire awareness
- Access and opportunities for “OMM-level” inspections available during
  - Wire improvement modifications
  - Other modifications such as cargo PC and new MMU
  - LRU R&R

OV-102 WIRE INSPECTION ASSESSMENT

Presenter: Doug White
Organization/Date: Orbiter/8-29-00

Modifications

- Wire improvement modifications have been baselined by the Program and are being implemented
  - Crit 1 circuit redesign
  - Separation of critical redundancy routing violations
  - Monoball production break
  - Aft Sidewall Wire Protection (ASWP)
  - Pyro harness heat shrink tubing
- Replace all clamp-to-clamp convoluted tubing in the aft with through-the-clamp tubing as soon as possible during upcoming flows
  - Inspect and repair all wire harnesses under convoluted tubing before re-installing it

OV-102 WIRE INSPECTION ASSESSMENT

Presenter: Doug White

Organization/Date: Orbiter/8-29-00

Acceptable for Flight:

- Root cause of mechanically induced damage remains the same
  - No new failure mechanisms found on OV-102
- OV-104 has been screened by a logical criteria and identified areas have been methodically inspected
- Areas of significant damage on OV-102 were inspected and repaired on OV-104
  - Exposed conductors between the ends of convoluted tubing and clamps or connectors
  - Exposed conductors in the backshells of the monoball connectors
  - Exposed conductors near connector backshells
- Confidence testing performed

OV-102 WIRE INSPECTION ASSESSMENT

Presenter: Doug White

Organization/Date: Orbiter/8-29-00

Acceptable for Flight:

- Potential still exists for damage in uninspected areas
- If undetected damage exists, consequences of damage are mitigated by Orbiter design
  - Orbiter electrical circuits contain design features (circuit breakers, fuses, RPCs, current-limiting resistors, etc.) to protect against effect of short circuits, including arc tracking
  - Arc tracking tests performed by JSC (1990) confirmed the effectiveness of Orbiter circuit protection devices
  - Critical Orbiter functions are redundantly powered
    - Most redundant power routed through separate wire bundles with maximum feasible physical separation

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

CRITICAL PROCESS CHANGES

STS-106 CRITICAL PROCESS CHANGE REVIEW SUMMARY

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Item Reviewed	No. of Items Reviewed	Period or Effectivity Covered	No. Found To Be Critical Process Changes
OMRSD Changes (RCNs)	41	STS-106 Specific & Non-Flight Specific Changes Approved 2/18/00 - 7/20/00	4
OMRSD Waivers & Exceptions	4	STS-106 Specific	0
IDMRD Changes (MCNs)	27	Approved 2/18/00-7/20/00	0
IDMRD Waivers & Exceptions	19	Approved 2/18/00-7/20/00	0
EDCPs	16	Closed 2/18/00-7/20/00	4
Boeing Specifications	144	Released 2/18/00-7/20/00	10
Boeing Drawings	922	Released 2/18/00-7/20/00	0
Material Review	1154	Approved 2/18/00-7/20/00	0

- All process changes were reviewed and none constrain STS-106
- Four key critical process changes are detailed on the following pages

STS-106 CRITICAL PROCESS CHANGES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

- OMRS RCN OS13862M - Increase in RCC Mission Life
  - Updated OMRS mission life values for selected RCC panels of the wing leading edge and nose cap resulting from analyses using the upgraded RCC 3D thermal/stress models (MCR 19066)
- EDCPs 12899 & 12902, MPS Gas Probe Specifications
  - EDCPs authorized changes in dimensions and leak rates to address corrective actions and conflicting requirements, also replaced obsolete cleaning specification and documented grinding and surface finishing processes to be used during build process

STS-106 CRITICAL PROCESS CHANGES

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

- MA0608-301: Corrosion Control and Finish Requirements
  - Change allows using tape to cover spots where studs that had been RTV'd onto structure are removed. Instead of sanding away all RTV, possibly damaging structure, tape is used over residual RTV
  - Same technique and tape already used for payload ground strap attach point surfaces
- ML0601-9024: Process 301 - TPS Reusable Surface Insulation (RSI) Maintenance, Tile Installation
  - Changes incorporated as a result of OV-103 lost tile investigation and corrective actions
    - Fabrication of IML/SIP mylar for 0.090/0.115 SIP tiles and selected 0.160 SIP tiles for additional verification of no SIP-to-filler bar interference
    - Incorporation of manual deflection test for all 0.090/0.115 SIP tiles

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

CONFIGURATION CHANGES AND CERTIFICATION STATUS

FIRST FLIGHT OF ADVANCED MASTER EVENTS CONTROLLER

Presenter:
Doug White
Organization/Date:
Orbiter/08-29-00

Item:

- First flight of the redesigned Advanced Master Events Controller (AMEC)

Discussion:

- There are two AMEC/EMEC/MEC LRUs per Orbiter
  - AMEC/EMEC/MEC provides for the transfer and signal conditioning of control and measurement data between the GPCs, the Orbiter, External Tank (ET), and Solid Rocket Booster (SRB) pyrotechnic and control devices
- The AMEC is functionally equivalent to the EMEC
  - Same performance and reliability improvements over the MEC design
    - Eliminates crit 1R2 inadvertent PIC firing
    - Reduce possibility of loss of a core due to a single channel failure
    - Reduced part count, solder joints, weight and power
  - Solves EEE parts availability problems by replacing two obsolete components

FIRST FLIGHT OF ADVANCED MASTER EVENTS CONTROLLER

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Actions Taken:

- Qualification testing (4/98 to 1/99) and analysis fully qualified the AMEC to Orbiter specifications
- Testing was performed at SAIL/JAEL from May 1998 through February 2000 to demonstrate transparency
- AMEC design was successfully operated over 1,800 hours in SAIL/JAEL during system level test with no anomalies
- Certification was approved in February 2000
- FMEA/CIL, OMRS and LCC changes are complete
- AMEC S/N 2, installed in OV-104, is ready for flight:
  - Successfully completed ATP at Autonetics, burn-in testing at SAIL and OMRS testing at KATS lab and in OV-104
  - Subsequent OV-104 system testing requiring use of the AMEC has demonstrated successful use in an operational environment

FIRST FLIGHT OF ADVANCED MASTER EVENTS CONTROLLER

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Actions Planned:

- MECs will be replaced by AMECs across the Orbiter fleet within the next two flights of each vehicle

Acceptable for STS-106 Flight:

- AMEC is fully qualified for flight according to Orbiter specifications
- Differences between AMEC, EMEC and MEC were evaluated, tested, and pose no performance or safety concerns
- AMEC design was successfully operated over 1,800 hours during system level test with no anomalies
- AMEC S/N 2, installed in OV-104 for STS-106, completed over 960 hours of successful operation during SAIL burn-in testing, ATP and OMRSD checkout

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

SPECIAL TOPICS

ORBITER SPECIAL TOPICS

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Topic	Presenter
MEDS IDP MSU Failure	Doug White
OMS Engine Transducer Gaps	Doug White
MPS LH_2 Manifold Repair	Tim Reith
Potential Contamination of MPS GO_2 Pressurization System	Tim Reith
LO_2 Prepress Disconnect Damage	Tim Reith

IDP "HALT" DUE TO MSU FAILURE

Presenter: Doug White
Organization/Date: Orbiter/08-29-00

Observation:

- MEDS Integrated Display Processor (IDP) halted unexpectedly following a Mass Storage Unit (MSU) failure

Concern:

- An MSU failure could cause loss of an IDP

Discussion:

- The IDP provides basic command & display functions:
  - Crew keyboard to GPC command interface
  - Visual outputs of GPC for crew display
  - Subsystem performance data from the ADC for crew display

IDP "HALT" DUE TO MSU FAILURE

Presenter: Doug White
Organization/Date: Orbiter/08-29-00

Discussion: (cont)

- Repeatable failure signature is observed:
  - IDP powers up nominally
  - ~12 seconds later a continuous "mechanical whirring sound" is heard from the box
    - MSU is the only rotating/moving element in the IDP
  - ~24 seconds later, a SCSI MSU (hard drive) failure summary bit in OST (Operational Self Test) is reported continuously
  - ~29 to 64 seconds later the IDP halts
- Analysis of diagnostic error information indicates the MSU is reporting a "medium error: unrecovered read error" several times per second
- IDP OST error conditions are temporarily stored in the status change event queue (up to 30 events) and then written to the IDP.OST file on the IDP MSU

IDP "HALT" DUE TO MSU FAILURE

Presenter: Doug White
Organization/Date: Orbiter/08-29-00

Discussion: (cont)

- Every time the IDP software attempted to write to the IDP.OST file it resulted in the failed MSU generating four OST error conditions (initial attempt plus three re-tries)
- Since the IDP software could not successfully write to the IDP.OST file, the status change event queue overflowed and halted the IDP
- The IDP software is designed to halt the IDP when this queue overflows
  - If this failure did not occur on the area of the hard drive where IDP.OST is stored, the IDP would not halt

Actions Taken:

- Review of IDP software showed there are no other cases where any combination of events could cause the IDP.OST queue to overflow

IDP "HALT" DUE TO MSU FAILURE

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Actions Taken (cont):

- Research found this to be the first time an MSU failure has halted an IDP in over 150,000 hours of IDP operation
  - Previous experience with unrecovered read access errors did not halt IDP operation
- After isolation of the failure, the Disk Drive Cartridge (DDC) from the failed MSU was removed and routed to the subtier supplier, Raymond Engineering, for TT&E
  - Bearings are noisy and have irregular stiction when turned by hand, but motor is still able to turn at design speed
  - Vendor believes bearing irregularity is causing a slight radial displacement which the heads are unable to track
  - Media and heads are normal
- IDP certified for 18,000 hours of operation
  - IDP with failed MSU logged over 20,000 hours of operation
  - IDPs installed in OV-104 have approximately 2000 hours of operation

IDP "HALT" DUE TO MSU FAILURE

Presenter: Doug White
Organization/Date: Orbiter/08-29-00

Actions In-work:

- A permanent software change has been developed which prevents the IDP software from accessing the IDP.OST file or any of the other seven error files if any access to that file has failed
- Implementation of this software change for STS-106 is not desirable due to minimal shelf life available prior to flight
  - Risks associated with minimal shelf life of an IDP software change outweigh the risk of a repeat of this failure mode
- The plan is to fly as-is and implement the software change for future MEDS flights

IDP "HALT" DUE TO MSU FAILURE	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

Risk Assessment:

- Criticality of the IDP is 1R3
- Loss of IDP function during the countdown would result in launch scrub
- Loss of one or two IDPs during ascent or entry is accommodated in the system redundancy design providing the ability for the crew to safely continue to orbit/land the vehicle
- Loss of an IDP during on-orbit operations would result in an in-flight maintenance (IFM) operation recovering full 1R3 redundancy to continue to NEOM

IDP "HALT" DUE TO MSU FAILURE

Presenter: Doug White
Organization/Date: Orbiter/08-29-00

Acceptable for STS-106 Flight:

- The IDPs have accumulated over 150,000 hours of operation with no other reported "halt" failures due to the MSU
- Should this failure occur prior to flight, the LCC does not allow launch with a failed IDP
- Should this failure occur during flight
  - During ascent or entry two IDPs can fail to halt with the remaining IDP providing the ability for the crew to safely continue to orbit/land the vehicle
  - During on-orbit operations, the crew can replace any failed IDP with the IDP4, recovering full 1R3 redundancy for entry, and continue to NEOM

OMS ENGINE TRANSDUCER GAPS

Presenter: Doug White
Organization/Date: Orbiter/8-29-00

Observation:

- During KSC inspection of WSTF rebuilt OMS engine S/N 114, out-of-spec transducer gaps were measured
- Subsequent inspection of available OMEs at KSC revealed additional out-of-spec gaps

Concern:

- Proper gap measurement ensures both primary and backup seals are engaged
  - Loss of backup sealing occurs if gap is too large

Discussion:

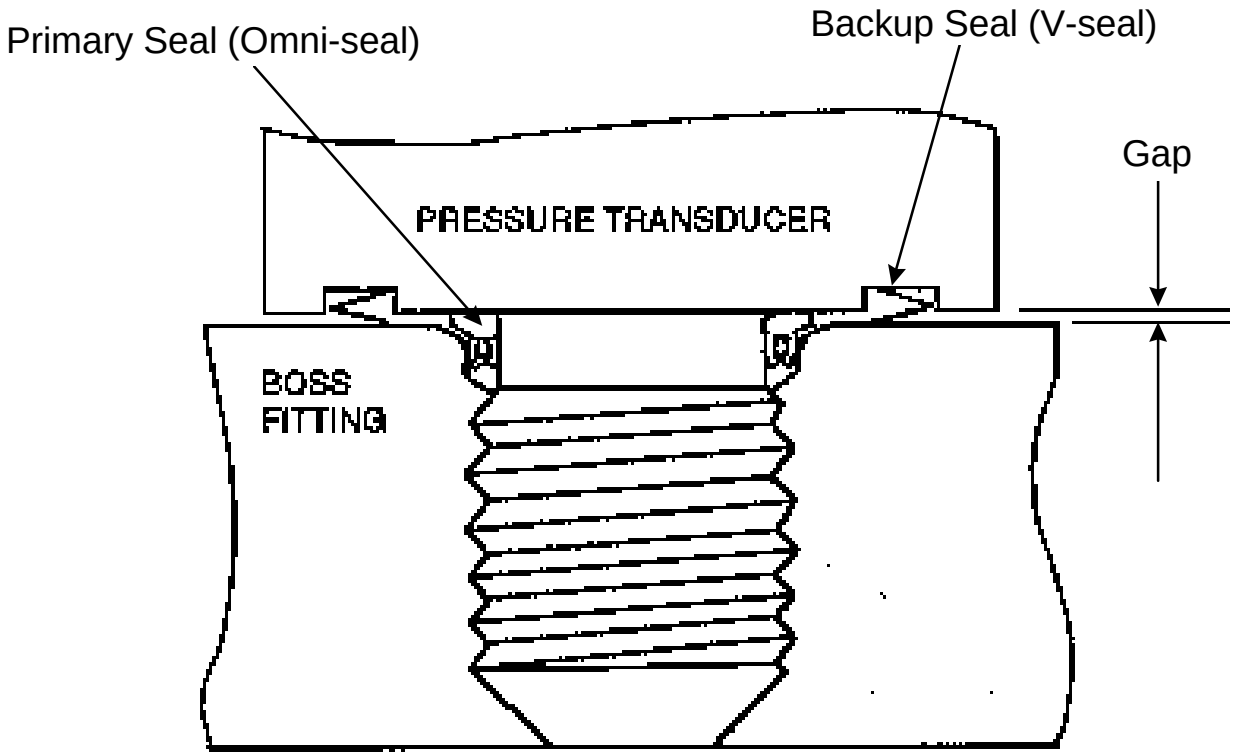
- OMS engine transducer bosses have primary and backup seals to protect against leakage
  - Omni-seal and V-seal
- Drawings specify torque and gap requirements to ensure both seals are engaged
- Leak check performed to verify seal
  - Unable to confirm both seals are engaged by leak check

OMS ENGINE TRANSDUCER GAPS

Presenter:
Doug White

Organization/Date:
Orbiter/8-29-00

Transducer/Boss Configuration



OMS ENGINE TRANSDUCER GAPS

Presenter: Doug White
Organization/Date: Orbiter/8-29-00

Actions Taken/Planned:

- Performed transducer/boss gap measurements on OV-104 OMEs to ensure seal engagement exists
  - All gaps on LH OME are per print
  - P_C, fuel, and oxidizer pressure transducer gaps on RH OME are per print
    - Temperature transducer gap is 0.005” and will be MR accepted as-is
    - Two GN_2 pressure transducer gaps, PT5 and PT6, measured 0.006” and 0.007”, respectively
      - Will be removed and replaced before flight

Acceptable for STS-106 Flight:

- Engagement of primary and backup seals will be verified by ensuring transducer to boss gap is≤ 0.005”

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Observation:

- Dye penetrant inspection of gouge located on the OV-104 LH2 feed manifold bellows revealed through-damage of the outer bellows ply prior to STS-101
- X-rays taken during STS-106 flow indicate that the damage may also exist in the inner ply

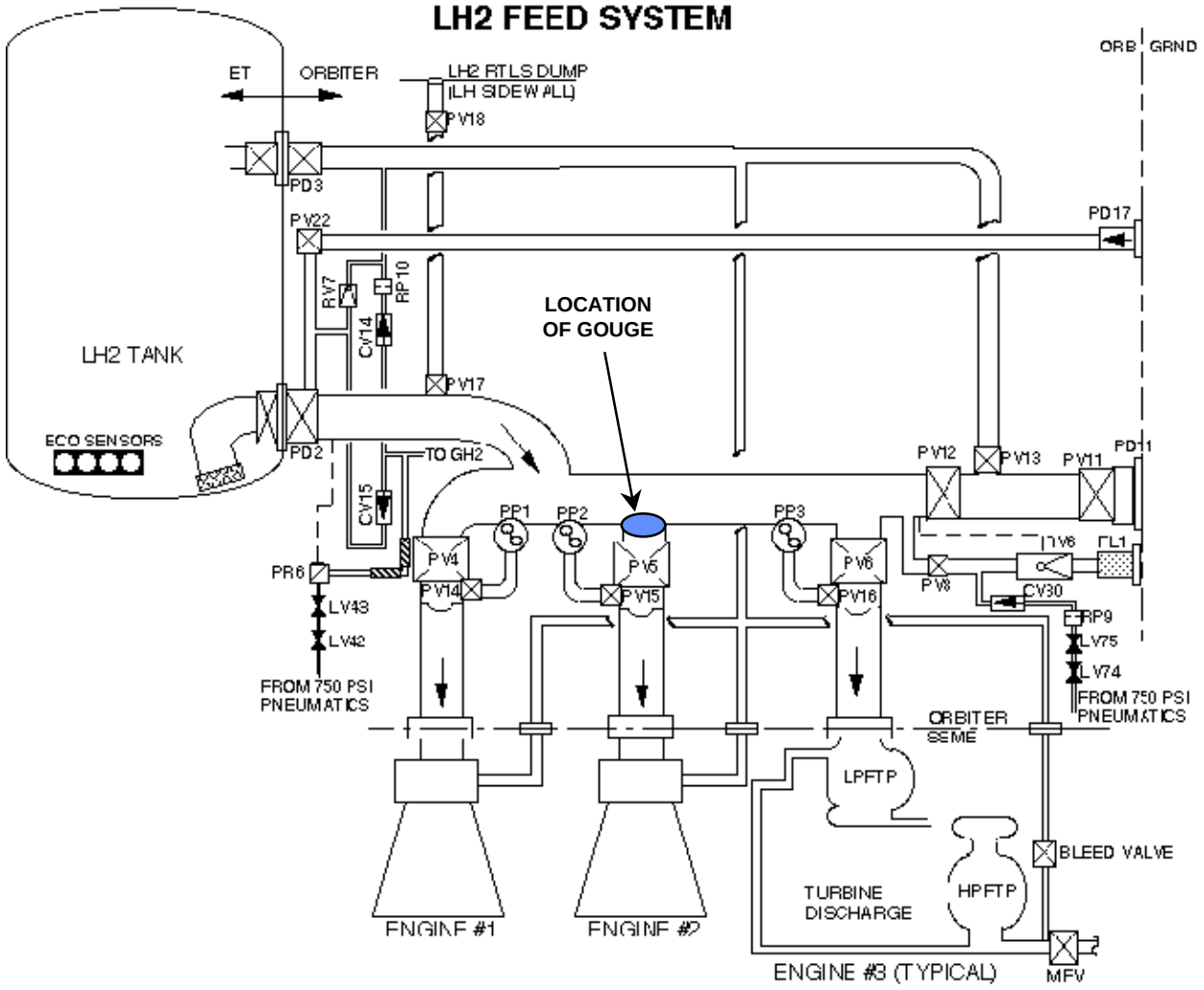
Concern:

- Potential for complete loss of vacuum insulation around LH2 feed system manifold
  - Loss of vacuum during propellant loading would result in failure to maintain proper LH2 system temperature for SSME start (LCC protected)
  - Launch scrub risk

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith

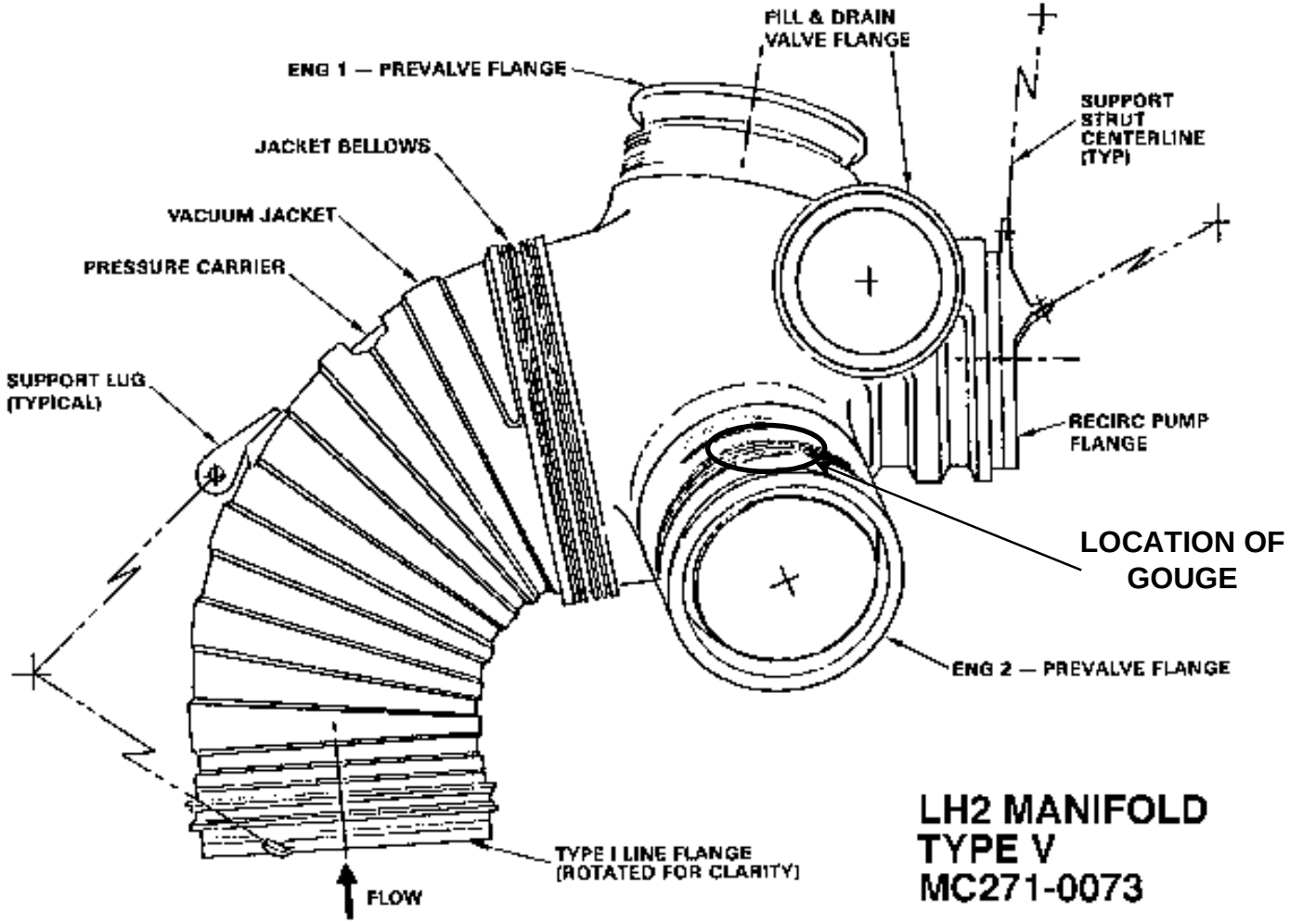
Organization/Date:
Orbiter/08-29-00



OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

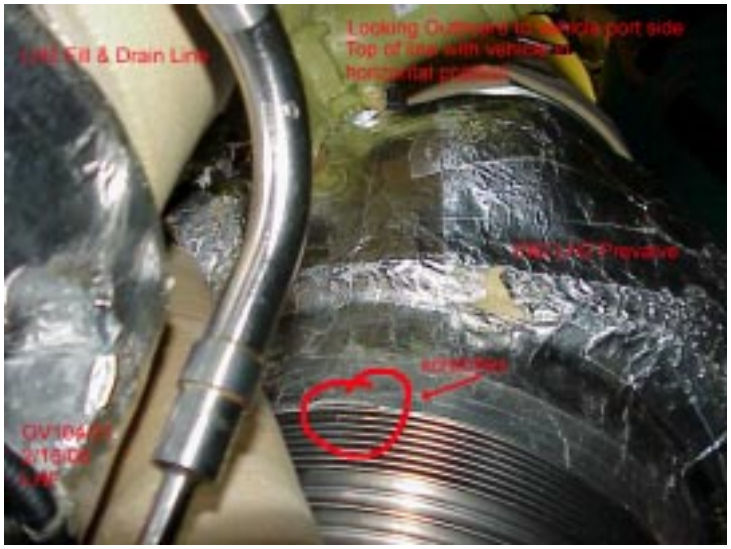


OV-104 LH2 MANIFOLD BELLOWS DAMAGE

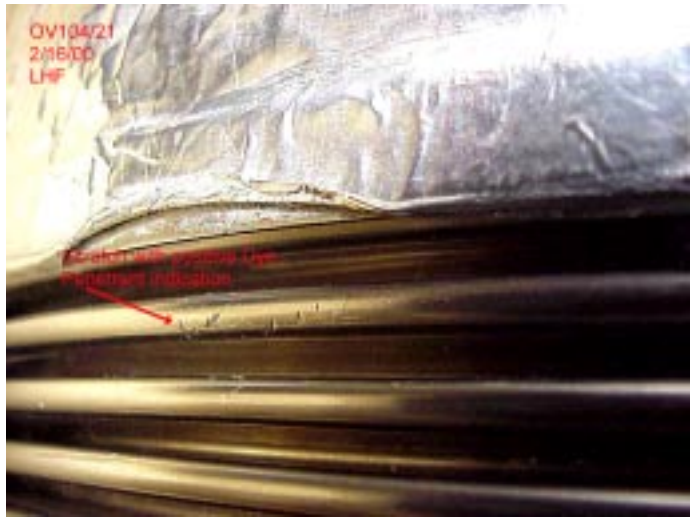
Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Overall View



Closeup View



OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter: Tim Reith
Organization/Date: Orbiter/08-29-00

Discussion:

- Primary function of bellows is to allow relative motion between the pressure carrier and vacuum jacket due to thermal differential that occurs during cryo loading
  - Manifold bellows are a two-ply configuration
  - Each ply is 0.010” thick Inconel 718
  - Single vacuum annulus surrounds LH2 manifold
- During flow 19 processing, six gouges were detected on the first convolute of the LH2 manifold bellows upstream of the Engine 2 prevalve flange
  - Mold impressions ranged from 0.002” to 0.005” deep
  - Vacuum jacket data, taken before and after damage was detected, was unchanged - approximately 45 microns

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter: Tim Reith
Organization/Date: Orbiter/08-29-00

Discussion: (Cont)

- Analysis determined that more than 100 missions worth of life existed for cyclic fatigue due to the worst case gouge (0.005”)
- Dye penetrant inspection performed during STS-101 flow showed positive indication on one of six gouges
- X-ray of bellows prior to STS-101 confirmed outer ply through-damage but showed no damage to inner ply
  - Vacuum level rechecked, showing that inner ply is maintaining vacuum at previous value of 45 microns
- STS-101 cleared for flight by analysis indicating 3 psid buckling margin beyond worst case aft compartment overpressure scenario for a single ply

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Actions Taken Since STS-101:

- Vacuum level rechecked and verified to be stable
- X-rays of damaged area taken
  - USA & Boeing NDE agreed that the potential for damage to the inner ply could exist
- X-rays taken again in an attempt to provide better detail of possible inner ply damage
  - X-rays reviewed by USA, Boeing, & NASA NDE groups
    - All three organizations concurred that it is still not possible to positively clear the inner ply as damage-free

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Actions Taken Since STS-101 (cont):

- Analysis performed to assess buckling and fracture margins with inner ply damage
  - Buckling margin remains unchanged (19 psid capability versus 16 psid maximum required) since vacuum jacket geometry/shape has not changed
  - Fracture analysis of 50% through scratch inner ply damage and worst case orientation (circumferential) shows no unstable flaw growth due to a thermal load cycle event
    - Flight vibration load cycles shows possible through-flaw breach failure after 5 flights
    - Unstable growth of through-flaw may occur after subsequent flight
  - Assessment of outer ply through-hole size/orientation indicates outer ply damage will not propagate
    - Suggested an MR repair to seal outer ply hole and restore redundant barrier is feasible

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Outer Ply Vacuum Repair:

- One-flight MR repair developed
  - Utilizes L-T-80 tape to provide vacuum barrier
- Development test article
    - Single incision damage with L-T-80 tape repair
    - Extended evacuation pump down
    - Mass Spec Leak Test
    - Monitor and record vacuum decay
    - Low temperature thermal cycling (ambient to -30 F)
    - Loading environment compression cycles
- Verification test article
    - Same as development except 3 incisions on test article

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

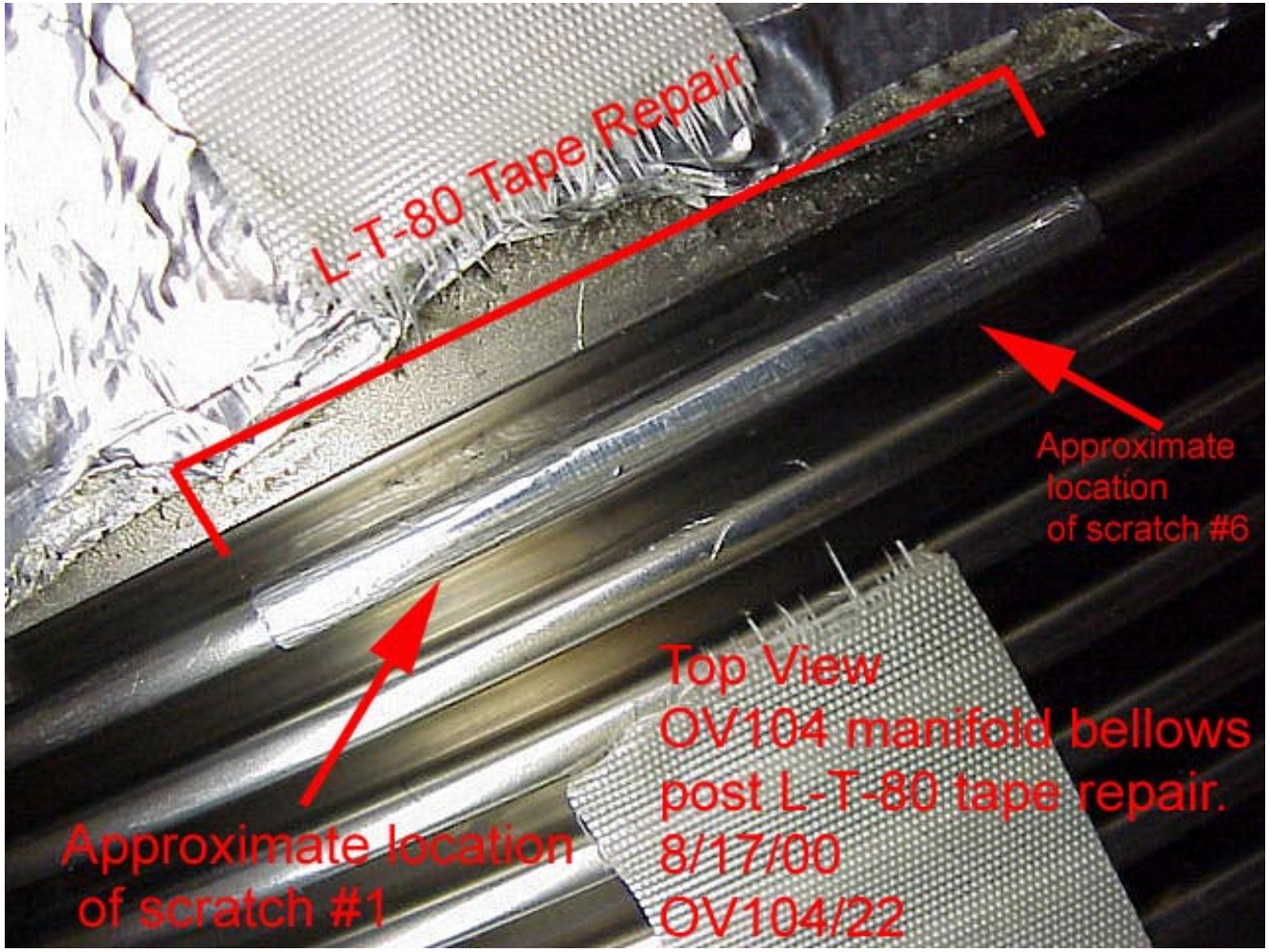
Summary Of Results:

- All test articles passed all mass spec leak checks with essentially zero leakage (less than $1x10^{-8}$)
- All test objectives satisfied
- Laboratory tests verified future X-rays will not be obscured by tape repair
- If inner ply defect X-ray is questionable, tape can be removed to verify vacuum integrity and then reapplied

OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00



OV-104 LH2 MANIFOLD BELLOWS DAMAGE

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Acceptable for STS-106 Flight:

- Vacuum level is currently stable
  - Vacuum level will be reverified prior to flight
- Loss of vacuum is Crit 3/3
  - LCC protected through LH2 system temperature monitoring
- Buckling capability is unchanged from previous flight
  - 3 psid of capability beyond worst case aft compartment overpressure scenario
- One flight MR repair complete
  - Repair provides redundant barrier if inner ply should fail prior to launch

OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Observation:

- Inspections of SSMEs flown on STS-101 revealed contamination in the LO2 Anti-Flood Valve (AFV)

Concern:

- Concern regarding possible implication to Orbiter GO2 system plumbing
  - Blockage of critical flow passages
    - Criticality 1/1 due to violation of ET ICD minimum structural capability
  - Particle impact ignition
    - Criticality 1/1 due to high velocity/high temperature environment

OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Discussion:

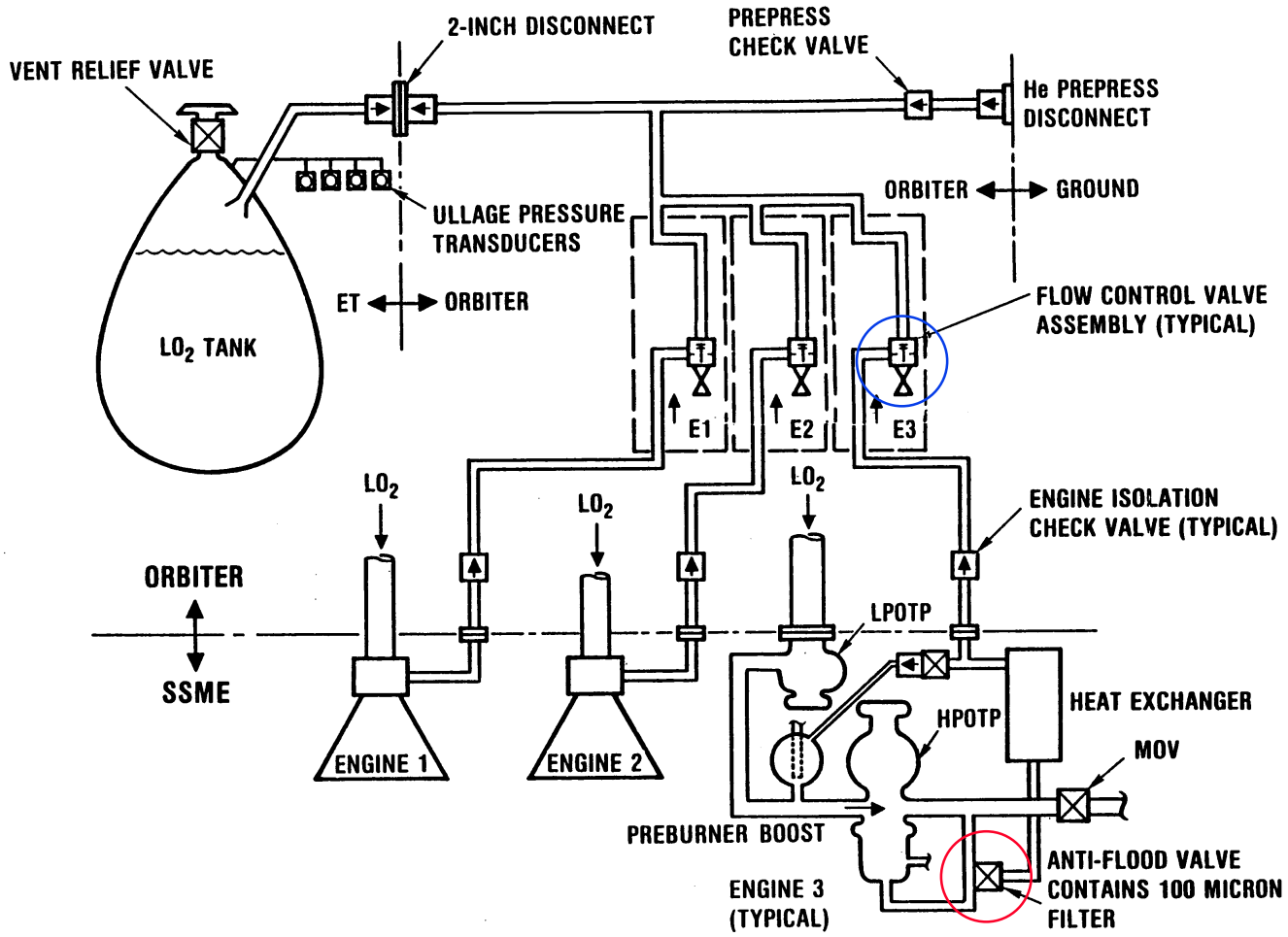
- AFV located upstream of heat exchanger (HEX)
  - Prohibits LO2 from entering HEX during loading operations
- During SSME run, a portion of the LO2 delivered to the SSME passes through AFV and HEX and returns to the Orbiter GO2 system to be used as pressurant for the ET LO2 tank
  - 3500 psia, 400°F, 2 lb/sec
- GO2 passes through an isolation check valve at the Orbiter/SSME interface, through a Flow Control Valve (FCV), and then combines with the other two SSME return flows before passing through the Orbiter/ET 2 inch disconnect
  - Inspections at Orbiter/SSME and Orbiter/ET interfaces did not reveal any traces of contaminant in GO2 system

OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

GO_2 Pressuration System



OV-104 GO2 SYSTEM CONTAMINATION	Presenter: Tim Reith
	Organization/Date: Orbiter/08-29-00

Discussion: (cont)

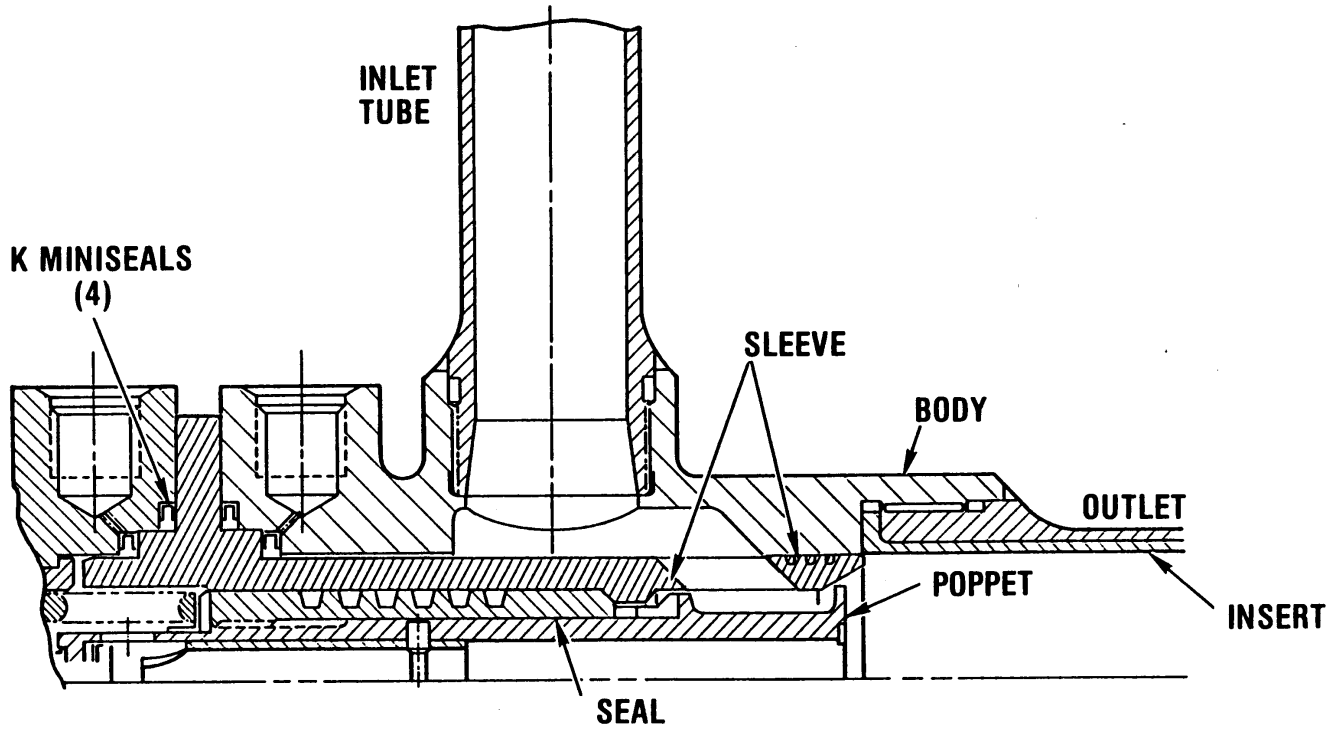
- FCV is limiting orifice in flow path
  - Since STS-40, GO2 FCVs have been fixed orifice
    - Shimmed to 78% of full flow capability
    - Annular flow around poppet
      - Minimum dimension approximately 800 μ
  - Current flight design tolerance is +/- 1.5%
    - Four-way swap of FCVs performed in 1996 to support Performance Enhancements
  - Sensitivity to blockage in system is high
    - Post-flight reconstruction is performed to verify FCV orifice integrity
      - STS-101 results were nominal

OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

MPS GO_2 Flow Control Valve



OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Discussion: (cont)

- Following STS-101, SSME 2054 post-flight borescope inspections revealed white contaminant located in AFVs
  - Determined to be residual from cleaning solution
- Further inspections of downstream SSME plumbing revealed small amounts of white powder
  - Less than 50 μ in size
  - Same composition as that found in the AFV
- Review of vendor records revealed that all three STS-101 AFVs were processed at the same time
  - Same cleaning and heat treat lot

OV-104 GO2 SYSTEM CONTAMINATION	Presenter: Tim Reith
	Organization/Date: Orbiter/08-29-00

Discussion (cont):

- Destructive analysis performed on SSME 2054 AFV
  - Contaminant assessed at ambient, cryogenic and following ultrasonic cleaning
  - Contaminant very difficult to remove; required significant mechanical force
    - Contaminant which could be liberated disintegrated into a fine powder
      - Largest particle measured less than 30 μ
    - Similar in nature to contaminant found in bellows
  - Results also consistent with previous Navy investigations performed on silicate cleaners

OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Discussion (cont):

- Contaminant also evaluated for particle ignition potential
  - Composition of contaminant is not a particle impact ignition threat
    - Cleaning solution comprised of elements which do not promote/support impact ignition
    - Size of liberated particles also not a threat to potential impact sites within GO2 system

OV-104 GO2 SYSTEM CONTAMINATION

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Acceptable for STS-106 Flight:

- STS-101 GO2 performance reconstruction did not show any indication of system blockage
- Inspections prior to SSME installation and Orbiter/ET mate did not reveal presence of contamination
- Destructive analysis of SSME 2054 AFV proved that contaminant is very difficult to remove
- Any contaminant which may be liberated disintegrates into powder form which will easily pass through Orbiter GO2 system
- All three STS-101 AFVs processed as one lot
- Size and composition of contaminant does not pose a threat of particle impact ignition

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Observation:

- During MPS helium signature test, out-of-family leakage was detected from the GO2 pressurization system

Concern:

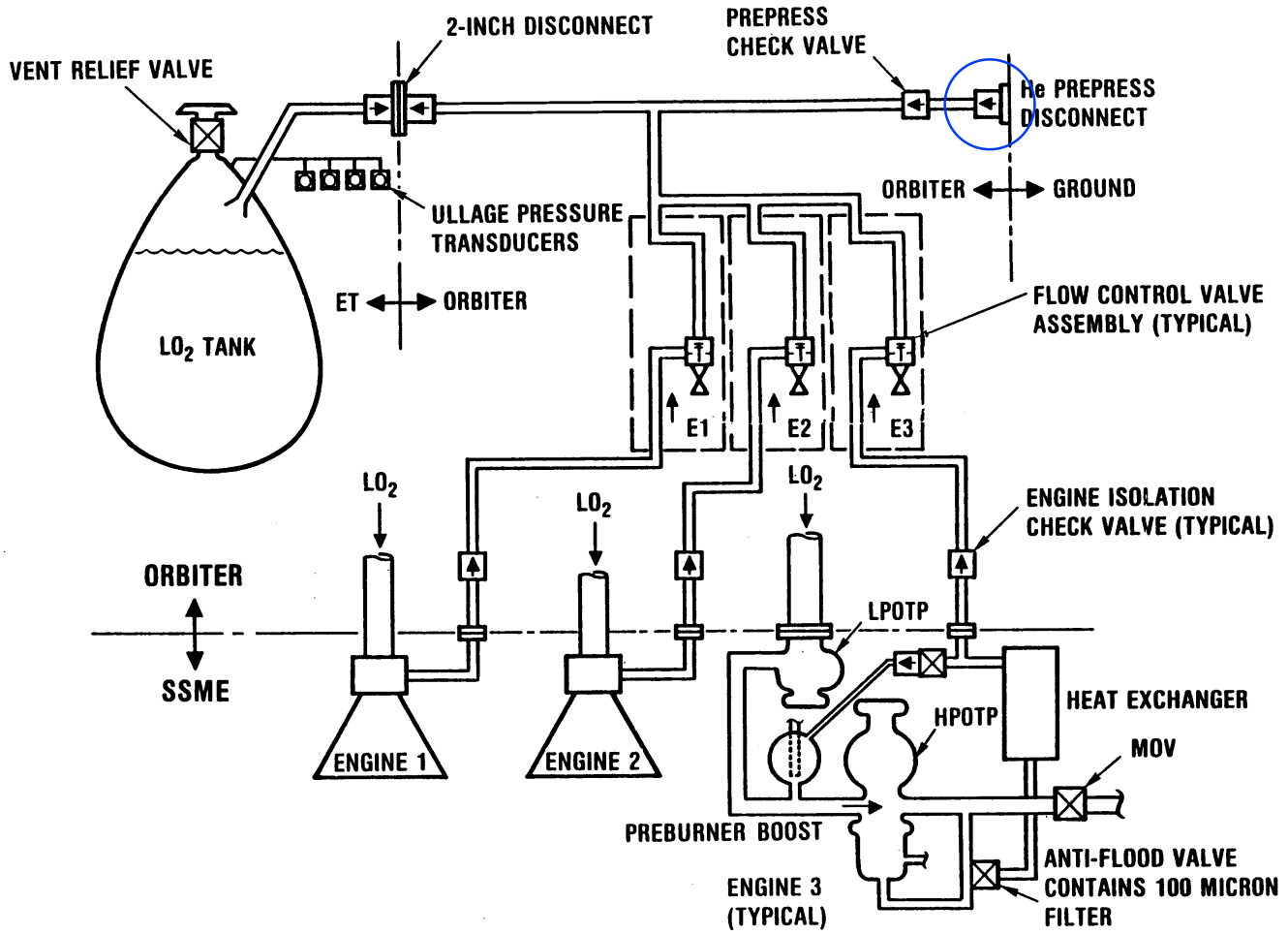
- Leakage during propellant loading or SSME operations could result in hazardous amounts of GO2 in the aft compartment
- Leakage during SSME operations could result in loss of ET LO2 tank ullage pressure

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

GO_2 Pressuration System



OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Discussion:

- GO2 pressurization system participates in three critical functions
  - LO2 tank pressurizations during cryogenic loading and prior to flight
  - Anti-icing purge during loading
  - LO2 tank pressurization during SSME run
- Loss of effectiveness of any of these functions due to leakage could result in either a launch scrub or, worst case, a criticality 1 failure

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Discussion: (cont)

- Troubleshooting of the observed leakage involved isolating individual systems
  - After ground side of GO2 pressurization line was vented, leakage immediately decreased to zero
    - Indicated leakage source located upstream of CV16
- Point-to-point leak checks of the line upstream of CV16 revealed a significant leak at Prepress Disconnect, PD9
  - Ground half of PD9 was removed and two anomalies were observed
    - Pressure assisted interface seal installed backwards
    - Locking pin used to hold seal retainer was not properly retracted into retainer
  - Inspections of Orbiter half showed that two gouges had been created by interference with locking pin

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

PD9 Ground Half

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

PD9 Flight Half

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith
Organization/Date:
Orbiter/08-29-00

Actions Taken:

- Ground half disconnect replaced
- Mold impressions of flight half disconnect showed damage confined to an area 0.303” x 0.112”
  - Maximum depth measured was 0.0026”
  - Minor amount of raised metal at the inboard end
- Disconnect halves remated
  - Successfully passed leak check
  - Helium signature rest for GO2 system reperformed
- Due to nature of damage to Orbiter half, potential for metallic contaminant in GO2 system does exist
  - Based on worst-case dimensions from mold impression, up to 6 mg could be present
    - Previous analyses and testing for particle impact ignition envelope this small amount of contaminant

OV-104 LO2 PREPRESS DISCONNECT DAMAGE

Presenter:
Tim Reith

Organization/Date:
Orbiter/08-29-00

Acceptable for STS-106 Flight:

- Ground half disconnect has been replaced
  - Correct installation of interface seal eliminates loss of anti-icing purge failure scenario
- Helium signature test of GO2 pressurization system has been successfully reperformed
  - Verifies Orbiter GO2 plumbing ready to fly
- Isolating leakage to interface side of PD9 eliminates criticality 1 failure scenarios during SSME run
- No risk of particle impact ignition

	Presenter: Doug White
	Organization/Date: Orbiter/08-29-00

GFE

GFE SPECIAL TOPICS

Presenter: Doug White

Organization/Date: Orbiter/08-29-00

Topic	Presenter
High Metals Content in SORG Water	Doug White
Space to Space Communication System	David Lee

HIGH METALS CONTENT IN SORG WATER

Observation:

- Elevated levels of nickel, manganese, iron, and cadmium were found during the Shuttle Orbiter Repackaged Galley (SORG, S/N 1005) post-servicing water sampling for OV-104, STS-106
  - Additional samples isolated high mineral content to the hot water side
  - Additional samples also showed that a flush could reduced mineral levels below the Shuttle spec

Concern:

- High metal levels are unacceptable for flight

HIGH METALS CONTENT IN SORG WATER

Actions Taken:

- SORG S/N 1003 was removed from OV-105 and installed in OV-104
  - Post-installation sample well within spec for metals
    - Odor was high (17 TON vs 15 TON spec) due to use of new lab which did not neutralize iodine prior to test
- SORG S/N 1005 was returned to JSC for analysis
  - Found high nickel, iron, and chromium levels in water from hot water tank (10 day dwell time)
  - Found high nickel levels in both hot and chilled water
  - Internal inspections found crevice corrosion in tank welds and some surface corrosion in several areas in hot and chilled sides
  - Galley will require cleaning and passivation before use to support STS-97
- Long term plan is to replace and redesign some components to reduce corrosion susceptibility

HIGH METALS CONTENT IN SORG WATER

Risk Assessment:

- Low risk for STS-106
  - Sample well within spec for newly installed SORG S/N 1003
  - SORG will be re-sampled at T-20 and T-3 days
    - If minerals are high in samples, galley can be flushed on launch day
  - Daily water use should keep minerals within spec
  - High mineral levels are detectable by crew taste
    - Since corrosion is more likely on the hot side crew can use chilled water only and can heat drink bags in oven

Acceptable for Flight:

- Sample well within spec for newly installed SORG S/N 1003

NASA
Johnson Space Center

Avionic Systems Division
GFE Projects Office

PRESENTED TO:

STS-106 FRR

STS-106 FRR
Space to Space Communications System (SSCS)

D. Lee/EV
8/29/00

- 10/98 SSCS first flew as DTO on STS-95
- 05/99 SSCS First Operational Flight was on STS-96
- Multiple anomalies identified and fixed:

	OR	ER	Anomaly Addressed
Baseband signal processor firmware changed	X	X	Undesirable Noise
Demodulator hardware changed	X	X	RFI
Modem programmable logic array and modem signal processor firmware changed	X	X	Network Lock-ups
Jumpers added	X	X	Network Lock-ups
Peak detector circuitry modified	X	X	Undesirable Noise
Added a ceramic filter for RFI rejection		X	RFI
RF relays replaced	X		Sticking Relays

- Certification Status

  The GCAR and delta certification data package have been approved by JSC SR&QA

  SSOR (SED 16102581-305) Cert Complete

  SSER (SED 16102580-307) Cert Complete

Strong signal discrepancy (FIAR JSCEV1232 6/22/00)

- SSOR radio has potential condition to degrade or interrupt its reception of another radio in close proximity (<1.2m) to the UHF Payload Bay Antenna.
- Current testing may not detect problem

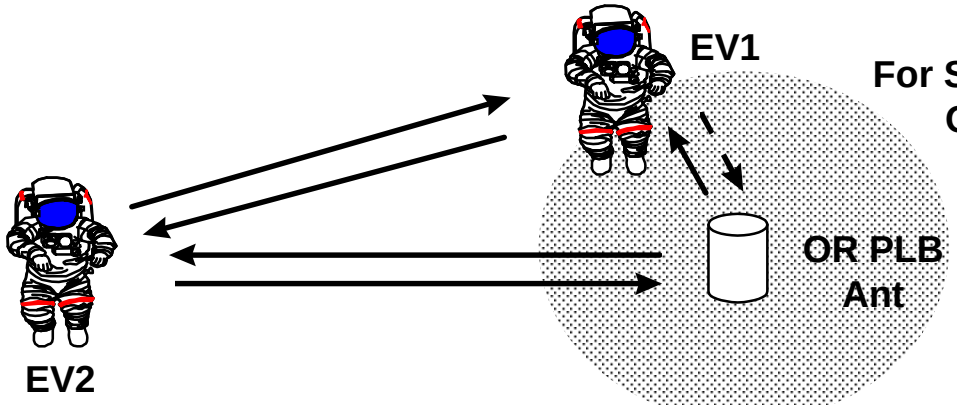
Description of discrepancy

- Strong signal conditions saturate internal amplifier;
  - Generates harmonic frequency noise in receiver front end
- Under most conditions this noise does not affect normal receiver performance
- Discrepant condition exists when noise interferes with received signal
  - Impacts SSOR ability to receive audio, biomed, EMU suit data
- A discrepant SSOR may escape detection through current screening tests (vendor ATP and JSC PIA)
- SSCS EMU radio has a different design; testing has demonstrated that the types of internally generated interfering harmonic noise that cause problems in the OR are not present in the ER.

- **<u>Characteristic of discrepancy</u>**

  <u>Network</u> (nominal 3 radio configuration)

  Testing has shown that an EMU (EV2) radio is not affected if it is beyond area of susceptibility:
  - Network retains stability and not affected
  - Only Orbiter radio reception of EV1 is affected
    - EV1 to EV2 two way comm remains intact
    - OR to EV2 two way comm remains intact
    - OR to EV1 one way comm remains intact
  - When EV1 moves away from PLB antenna, discrepancy automatically clears
    - No crew action will be required to resume nominal operation



For Strong Signal discrepancy at ER1-OR
Only EV1 to OR comm is affected

- **Characteristic of discrepancy (cont)**

  Susceptibility

  – Strong signal level susceptibility can be converted to equivalent distance between EMU and Orbiter PLB antenna

  – **Observed** to date
    – Worst case observed data: -5 dBm RF input into SSOR
    – Equivalent to a max distance of 1.2 meters from EMU-Orbiter PLB Antenna
  – **Analysis** indicates that causal mechanism (saturation) is bounded at -12 dBm
    – Equivalent to max distance of 2.7 meters from EMU-Orbiter PLB Antenna

  – Discrepant condition always disappears if subjected to either increasing or decreasing signal strength
    – "Sweet spot" phenomenon
    – Bandwidth of sweet spot typically < 3dB (equiv to 12 inches of displacement from PLB ant)

NASA Johnson Space Center *Avionic Systems Division* *GFE Project Office*	**Subject:** **Strong Signal Discrepancy**	**Name:** **D. Lee/EV**	
		Date: **8/29/2000**	**Page:** **GFE-2.2.6**

Recommendation: Fly AS-IS

Rationale:

- Worst case impact: Temporary loss of 1 way comm while in vicinity of PLB antenna
- Nominal plan does not identify any EVA activities within potential area of susceptibiltiy (2.7 meters from PLB antenna)
- Fixed radio unavailable
- MOD, EVA, S&MA in concurrence to fly as-is

Recommended Actions:

- Coordinate with MOD, ops procedures of off nominal EVA near PLB antenna
- Test and verify fix for SSOR strong signal discrepancy
- Implement new screening tests
- Track opportunities for delivery of fixed radios back into fleet

	Presenter:
	Organization/Date: Orbiter/08-29-00

BACKUP INFORMATION

	Presenter:
	Organization/Date: Orbiter/08-29-00

STS-101
IN-FLIGHT ANOMALIES
BACKUP

SPACE SHUTTLE PROGRAM
STS-101 MISSION
IN-FLIGHT ANOMALIES

Presenter:

Organization/Date:
Orbiter/08-29-00

IFA NO.	TITLE	FINDINGS/STATUS	EFFECT ON STS-106

STS-101-V-01	**LOME BIPROPELLANT VALVE 2 INDICATES OPEN**	• FOLLOWING THE NC2 BURN THE LOME BIPROPELLANT VALVE 2 (BPV-2) CONTINUED TO INDICATE OPEN
		• PREVIOUS 2 BURNS WERE NOMINAL
		• THIS WAS THE FIRST FLIGHT OF THIS OME (S/N 111) SINCE REFURBISHMENT AT WSTF (1997)
		• ENGINE WAS NOT USED DURING MISSION AGAIN UNTIL DE-ORBIT PER FLIGHT RULES
		  • BPV-2 OPEN INDICATION CONTINUED THROUGHOUT A NOMINAL BURN AND AFTER ENGINE SHUTDOWN
		  • LVDT-1 AND BPV-1 INDICATIONS WERE NOMINAL
		• KSC HAS PERFORMED BALL VALVE DRAIN OPERATIONS AND ISOLATED PROBLEM TO THE LVDT
		• IFA IS CONSIDERED “IN FAMILY” AND NOT A CONSTRAINT TO FLIGHT AFTER DISCREPANT HARDWARE HAS BEEN REPLACED
			• LVDT WAS R&R’d
			• LVDT IS CRIT 3/3

STS-101-V-02	LOME GN2 REGULATOR PRESSURE LOW DURING POST-BURN PURGES	• DURING THE OMS ASSIST START TRANSIENT, POST BURN PURGE, AND THE OMS 2 POST BURN PURGE, THE LOME GN2 REGULATOR PRESSURE INDICATED 296, 295 AND 297 RESPECTIVELY
		• FAILED TO STAY ABOVE FDA LIMIT OF 299 PSIA
		  • FDA ALARMS WERE GENERATED
		• UPON COMPLETION OF THE START TRANSIENTS AND PURGES, THE REGULATED PRESSURE RETURNED QUICKLY TO ITS NOMINAL VALUE OF 312 PSIA
		• THERE WAS NO MISSION IMPACT
		• DURING POST FLIGHT SAFING OPERATIONS AT KSC, OMS ENGINE GN2 VENT WAS PERFORMED
		  • REGULATOR PERFORMANCE WAS NOMINAL
		• PRT HAS RECOMMENDED TO HAVE KSC REMOVE AND REPLACE REGULATOR PRIOR TO NEXT FLIGHT OF OME
			• REGULATOR WAS R&R’d

SPACE SHUTTLE PROGRAM
STS-101 MISSION
IN-FLIGHT ANOMALIES

Presenter:

Organization/Date:
Orbiter/08-29-00

IFA NO.	TITLE	FINDINGS/STATUS	EFFECT ON STS-106
STS-101-V-03	KU-BAND RADIATING WITHIN THE RF PROTECT BOX	• DURING ORBITER / ISS DOCKING OPERATIONS, ON TWO OCCASIONS THE KU-BAND TRAVELING WAVE TUBE (TWT) RADIATED INTO THE RF PROTECT BOX • EACH OCCASION WAS BETWEEN 1-2 SECONDS DURATION • RADIATION TOOK PLACE WHEN THE ANTENNA WAS DRIVING FROM TDRS EAST TO TDRS WEST • TO PREVENT FUTURE OCCURRENCES, GROUND TURNED THE TRANSMITTER OFF IF THE TDRS WAS PREDICTED TO BE WITHIN THE BOX AT AOS	• SIMILAR PROCEDURE WILL BE UTILIZED GROUND CONTROLLERS TURNING THE TRANSMITTER OFF IF THE TDRS IS PREDICTED TO BE WITHIN THE BOX AT AOS

STS-101-V-04	PRSD O2 TANK 4 A HEATER TEMPORARILY FAILED	• DURING FLIGHT DAY 2 POST SLEEP CRYO RECONFIGURATION, THE O2 TANK 4 A AND B HEATERS WERE PLACED IN AUTO
		• FOLLOWING THE FIRST CYCLE (WHICH WAS NOMINAL), THE A HEATER DID NOT COME ON DURING SUBSEQUENT CYCLES
		• THE A HEATER SWITCH WAS CYCLED TO THE OFF POSITION AND THEN BACK TO THE AUTO POSITION
		  • BOTH A AND B HEATERS CYCLED AND THE FUNCTIONALITY OF THE HEATER WAS REGAINED
		• HEATER PERFORMED NOMINALLY THE REMAINDER OF THE MISSION WITH SEVERAL SWITCH THROWS
		• POST FLIGHT KSC TROUBLESHOOTING HAS BEEN PERFORMED AND NO PROBLEMS WERE NOTED
		  • DISPOSITIONED AS UA
			• LOSS OF A SINGLE HEATER IS CRIT 2R3 AND HAS NO IMPACT TO THE MISSION
			• REDUNDANT HEATER CAN BE USED TO PRESSURIZE THE TANK

SPACE SHUTTLE PROGRAM
STS-101 MISSION
IN-FLIGHT ANOMALIES

Presenter:

Organization/Date:
Orbiter/08-29-00

IFA NO.	TITLE	FINDINGS/STATUS	EFFECT ON STS-106

STS-101-V-05	COLLINS TACAN BITE FAULTS	• DURING LANDING, COLLINS TACAN (POSITION 3) EXPERIENCED 2 BITE FAULTS
		  • THE TWO BITE LASTED FOR 3 AND 6 SECONDS
		• THESE BITE SIGNATURES ARE THE FIRST OCCURRENCE FOR A COLLINS TACAN DURING FLIGHT
		• ONCE THE TACAN LOCKED ONTO THE GROUND STATION, PERFORMANCE WAS NOMINAL
		• THE TACAN WAS R&R AND RETURNED TO COLLINS FOR TT&E
		  • FAILURE WAS ISOLATED TO THE Q7 TRANSISTOR POWER AMPLIFIER MODULE
			• TACAN R&R'd
			• EACH VEHICLE IS EQUIPPED WITH THREE TACANS (CRIT 1R2)
			• SUCCESSFUL LANDING REQUIRES ONLY ONE OPERATIONAL TACAN
			• POTENTIAL FOR A SIMILAR FAILURE IN OV-104 TACAN #1 EXISTS; HOWEVER, THE REDUCED POWER IS NOT EXPECTED TO SIGNIFICANTLY AFFECT THE TACAN RANGE PERFORMANCE

STS-101-V-06	SLUMPED TILE AT THE WING LEADING EDGE WITH INTERNAL FLOW	• DURING POSTLANDING TPS INSPECTION, A SLUMPED TILE WAS DISCOVERED AT THE WING LEADING EDGE • GAP TO THE RCC T-SEAL WITH INDICATIONS THAT INTERNAL FLOW DID EXIST • INSPECTIONS (REQUIRING LESS PANELS BEING REMOVED) REVEALED THE BUTTERFLY GAP FILLER AT THE LOWER LESS PANEL 6 / 7 INTERFACE WAS NOT CORRECTLY INSTALLED • INSTALLED DURING OMM - THIS IS FIRST FLIGHT SINCE INSTALLATION • ALL HARDWARE WAS REINSTALLED AND INSPECTED PER PRINT	• DAMAGED HARDWARE WAS REPLACED OR REPAIRED • CORRECTIVE ACTION WAS IMPLEMENTED INCLUDING REFERENCE MARKING OF THE BUTTERFLY GAP FILLER PULL LOOPS TO ENSURE THEY ARE REINSTALLED CORRECTLY

	Presenter:
	Organization/Date: Orbiter/08-29-00

CONFIGURATION CHANGES

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/08-29-00

Thirteen Modifications Were Incorporated During The STS-106 Processing Flow:

- 5 modifications are flying for the first time
  - MCR 18775 Advanced Master Events Controller (AMEC)
  - MCR 18883 4 Advanced Air Data Transducers (AADTs)
  - MCR 19162 Hatch and Vestibule Floodlight Pip Pin Upgrade
  - MCR 19398 Space to Space Orbiter Radio (SSOR)
  - MCR 19469 Relocation of External Airlock O2 Line Temperature Sensor

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/08-29-00

OV-104 STS-106 First Flight Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Operational Enhancement 18775 Advanced Master Events Controller	X			01A-21-450-0016-0009B	2/9/00A	

- Master Events Controllers provide for the transfer and signal conditioning of control and measurement data between the GPCs and the Orbiter, ET and SRB pyrotechnic and control devices
- Replaces old configuration MEC (S/N 8) with new configuration AMEC (S/N 2) in slot 2
  - Eliminates criticality 1R2 failure modes for inadvertent PIC firing
  - Provides transparent fit and function to the existing MEC and EMEC configurations
- STS-106 will fly with one AMEC and one MEC

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/08-29-00

OV-104 STS-106 First Flight Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Operational Enhancement						
18883	X	X		01-17-409-0224-0002A	9/3/99A	• AADT
Advanced Air Data Transducer	X	X	X	08-22-613400-001H	10/13/98A	• ECLSS Ducting

- Installs remaining three of four AADTs
  - Single AADT demonstration program successfully completed on STS-103 (OV-103 flight 27), STS-99 (OV-104 flight 14) and STS-101 (OV-104 flight 21)
  - AADTs minimize and/or eliminate:
    - Accuracy testing after each flight
    - Drift rate tracking
    - Re-calibration
    - Sensor rework

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/08-29-00

OV-104 STS-106 First Flight Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Corrects Configuration 19162 Hatch And Vestibule Floodlight Pip Pin Upgrade	X			09-28-593201-001Q	8/8/00A	• HATCH PIP PINS – ERRATA TO CHANGE EFFECTIVITY FROM FLT 23 TO FLT 22 SUBMITTED 7/12/00
	X			103-27-534200-001B	8/4/00A	• VESTIBULE LIGHT PIP PINS – ERRATA TO CHANGE EFFECTIVITY FROM FLT 23 TO FLT 22 SUBMITTED 7/12/00

- Installs upgraded pip pins at external airlock aft hatch and ODS vestibule floodlights
  - Upgraded pip pin uses stronger A286 in place of CRES 303 and makes use of a one-piece spindle in lieu of the previous two-piece design which was susceptible to failure
  - The emergency egress slide portion of this modification was previously implemented for STS-101

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/08-29-00

OV-104 STS-106 First Flight Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Mission Requirement **19398** **Space to Space Orbiter Radio**						• GFE LRU CERTIFICATION

- **Converts Orbiter on-orbit EVA communication from ATC configuration to Space-to-Space Communication System (SSCS) by installing Space-to-Space Orbiter Radio (SSOR) and rerouting wiring**
- **The SSOR, previously flown on STS-96 (OV-103 flight 26), has been redesigned to correct problems found during flight test program**

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/08-29-00

OV-104 STS-106 First Flight Modification Certification

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
Operational Enhancement **19469** **Relocation of External Airlock Oxygen Line Temperature Sensor**				N/A		• TEMP SENSOR AND INSTALLATION COMMON TO PREVIOUSLY CERTIFIED CONFIGURATIONS

- **Relocates a temperature sensor from the external airlock QD to the adjacent oxygen supply line in heater zone 2 (V64T0186A)**
  - **The requirement to control oxygen supply temperature to the extravehicular mobility unit (EMU) was previously not supported by a direct temperature measurement**
  - **An existing sensor (V64T0183A) installed on the airlock QD panel has similar readings to the sensors installed adjacent to the panel and was therefore considered redundant**

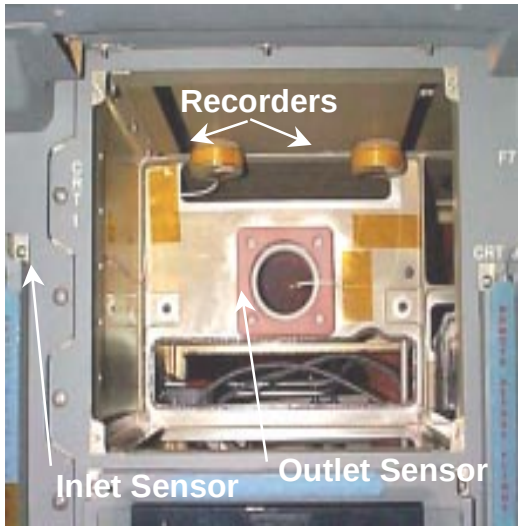
CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date: Orbiter/08-29-00

Orbiter Provided Mission Kit Changes:

- MV0072A Micro Wireless Instrumentation System (Micro-WIS) Monitoring of Crew Compartment Avionics Temperatures (MCR 19511)



Micro-WIS Recorders Installed at DPS 1 Location

- Temporary installation of Micro-WIS temperature recorders at inlets and outlets of six of the analytically determined “hottest” air-cooled crew compartment LRUs
  - MEDS Display Unit (DPS 1)
  - MEDS Integrated Display Processor (IDP 1)
  - Dedicated Display Unit (DDU 3)
  - General Purpose Computers (GPCs 1 & 2)
  - CCTV Monitor (CTVM 1)
- Provides insight into cooling margin during 10.2 psi EVA preparations when cabin temperature and avionics cooling balance is most critical
- Data gathering planned for STS-106 only; no crew action required since transmitters are not used for this application
- Certification by similarity (CAR 10-22-613400-001J) submitted 7/26/00 ECD 8/18/00

	Presenter:
	Organization/Date: Orbiter/08-29-00

CRITICAL PROCESS CHANGE BACKUP

STS-106 CRITICAL PROCESS CHANGE REVIEW SUMMARY

Presenter:

Organization/Date:
Orbiter/08-29-00

- OMRS RCNs OV13920, 21 & 24 - Implementation of Freon 113 Replacements Via SE-S-0073 Update
  - OMRS subsystem files updated to reflect use of Freon "or equivalent per SE-S-0073" (CR -S0161133D approved 6/00 updated SE-S-0073)
  - OCRs approved for each Orbiter subsystem for hardware specific data, additional implementation documents revisions to come (e.g. procurement specs, IDMRD, etc.)
- EDCP 2487- Marking Ink Material Change for Floodlight Lamp
  - EDCP authorized change from ceramic ink to marking paste for marking part number on metal halide lamp and change from ceramic ink to zirconium oxide reflective paint for marking arc gap of the center of lamp**.** Material changes were concurred upon by M&P, no concerns with toxicity or flammability

STS-106 CRITICAL PROCESS CHANGES

Presenter:

Organization/Date:
Orbiter/08-29-00

- EDCP APU-1663/R1, New Gas Generator Valve Module Leakage Resolution
  - EDCP authorized change to APU Hot Fire acceptance test to allow internal leakage on the GGVM Pulse Control Outlet and Shutoff Bypass seats up to 40 psid (was zero) as measured by the Gas Generator Chamber Pressure. Test and analysis used to determine this new limit acceptable for flight hardware
- MA0106-330: Adhesive Bonding, Sealing, Potting and Conformal Coating
  - Eliminated use of naptha/IPA mix when cleaning electrical connections prior to potting, coating, etc. Only use IPA
  - Required to be consistent with NHB 5300 and ML0 specs regarding solvent usage on electronics
    - Actual program practice has been IPA only

STS-106 CRITICAL PROCESS CHANGES

Presenter:

Organization/Date:
Orbiter/08-29-00

- MA0106-381: Solvent Bonding with Chlorinated Solvents
  - Changed option of using either Freon or IPA for precleaning to IPA only
    - Bonding still performed with methylene chloride
- MA0110-029: Surface Treatment of Fluorocarbon Wire Insulation
  - Eliminated use of either perchloroethene or Freon for precleaning and replaced with reference to MA0110-305, which defines established processes for pre-bond preparation of various surfaces, including fluorocarbons
- MA0106-352: Casting electrical components with Syntactic epoxy foam
  - Replaced option of using Freon, TCA, or IPA for precleaning with use of IPA only

STS-106 CRITICAL PROCESS CHANGES

Presenter:

Organization/Date:
Orbiter/08-29-00

- MA0108-311: Application of High Temp, High Emittance Coating
  - Added Inconel 718 to materials being coated with Pyromark
    - Corrective action for sector seal failures included changing materials to Inconel 718
    - No changes to basic process requirements
- MA608-301: Corrosion Control and Finish Requirements
  - Change allows using tape to cover spots where studs, that had been RTV'd onto structure, are removed. Instead of sanding away all RTV, possibly damaging structure, tape is used over residual RTV
  - Same technique and tape already used for payload ground strap attach point surfaces
- MB0135-068: Webbing, Fiberglass, PTFE coated
  - Change allows larger fiber diameter (supports procurement)
  - Requirement for elongation at breakage lowered to accommodate using a stiffer cloth
    - Lower values still consistent with substrate cloth

STS-106 CRITICAL PROCESS CHANGES

Presenter:

Organization/Date:
Orbiter/08-29-00

- MB0135-104: Cord, Polyimide, Braided, PTFE Coated
  - Changed filament size requirement to size that vendor (Albany International) reports has always been supplied
    - Vendor refused to supply material unless the spec was corrected
  - Removed flammability, odor, and other requirements at vendor's request because vendor is not able to certify that the material meets these requirements
  - Testing has always been performed by procuring agency
- MB0160-046: Yarn, Metallic Filament
  - Changes made in material (CRES 316 in lieu of 304), yarn twist (5 per inch in lieu of 6 per inch), and weight
    - Changes made to accommodate product from new supplier (original supplier no longer makes product)
    - New thread meets all mechanical, electrical, and service requirements (no changes made to these requirements)

NASA Johnson Space Center *Avionic Systems Division* *GFE Project Office*	**Subject:** **Strong Signal Discrepancy**	**Name:** **D. Lee/EV**	
		Date: **8/29/2000**	**Page:** **GFE BU-1**

GFE SPECIAL TOPIC

BACKUP

NASA
Johnson Space Center
Avionic Systems Division
GFE Project Office

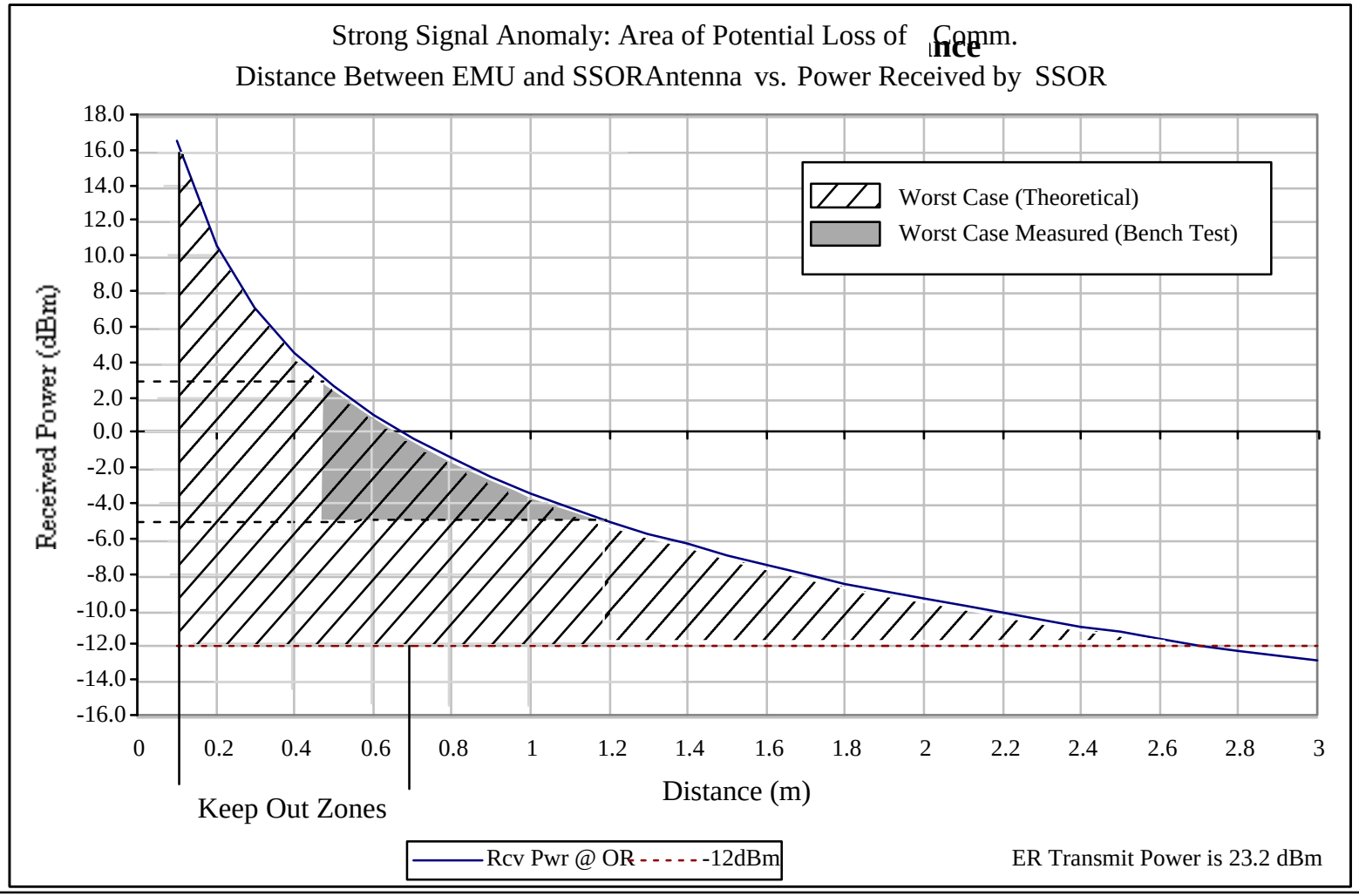
Subject:

Strong Signal Discrepancy

Name: D. Lee/EV

Date: 8/29/2000

Page: GFE BU-2



NASA
Johnson Space Center
Avionic Systems Division
GFE Project Office

Subject:

Strong Signal Discrepancy

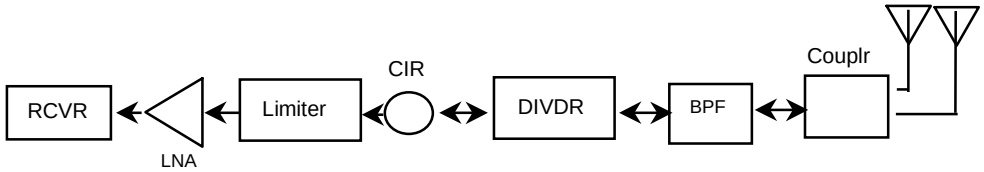
Name: D. Lee/EV

Date: 8/29/2000

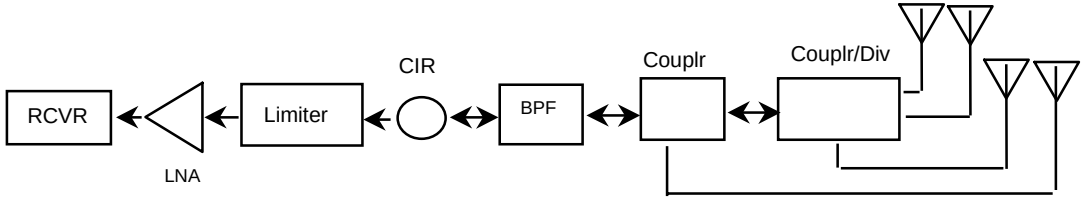
Page: GFE BU-3

SSER design is different from SSOR/SSSR

SSOR



SSSR

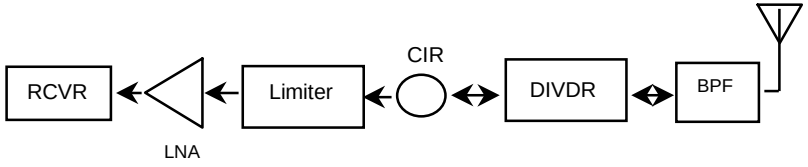


Limiter: Custom designed
- Printed circuit board construction

7 passive discretes, 2 microstrips
- High power special design

BPF:
- Large cavity filter design
- HIgh power capacity
- 5 section

SSER



Limiter: Commercial part
- 3 terminal device
- Monolithic chip design
- Active vs passive

BPF:
- Small ceramic design
- Low power
- 6 pole

Background

- The strong signal problem was first observed in July of 1998.
- Observed on SSSR
- Litton asked to analyze and fix because it was isolated to Limiter board, designed by Litton
- Litton enlists senior RF Engineer and conducts 1 week of analysis/test during 8/22-24/98
- Litton findings:
  - the breakup problem was caused by an interaction between the LNA on the limiter board and the external Cavity Filter
  - At about 20 dB of overdrive (approximately 0 dBm) a strong oscillation appears at 209 MHz,half the frequency of the Cavity filter.
  - As the signal level is increased, a more complex signal containing multiple frequencies appears
  - At yet higher levels, the oscillation amplitude and complexity diminishes and disappear, as the front end limiter begins to clamp the input signal, providing additional isolation between the cavity filter and the LNA.

Background

- Litton recommendation
  - 1st choice: Redesign front end with AGC
  - 2nd choice: Damp oscillations (selected due to practicality)
    - Damp oscillations details:
      - With further experimentation, it was observed that a 1 dB pad between the Cavity Filter and the LNA would stop the destructive oscillations.
      - Change capacitor C10 (in front of LNA) to create same effect
- This patch has been implemented on all SSSR radios and there have been no recurrences of this problem with current testing techniques.
- The Orbiter radio has the same limiter board as the SSSR, however, this phenomenon has never caused an orbiter radio to fail ATP until now (sn 1008)

Keep Out Zones (from Payload Bay Antenna)

Low power: **0.14m**

Hi power: **0.7m (overhead), 0.4 (side)**

NASA Johnson Space Center *Avionic Systems Division* *GFE Project Office*	Subject: **Backup**	Name: D. Lee/EV	
		Date: 8/29/2000	Page: GFE BU-7

Assuming minimum losses and the antenna orientations that will transfer the most power, here are the numbers:

SSER transmit power:	23.2 dBm	
SSER antenna cable loss:	-0.2 dB	
SSER antenna gain:	-1.5 dBi	
Space Loss:	-21.4 dB	(0.68 meters)
Polarization Loss:	-3.0 dB	
SSOR antenna gain:	5.0 dBi	
SSOR antenna cable loss:	-2.1 dB	
Received power at the SSOR:	0.0 dBm	

At a distance of 0.5 meters, the received power goes up to 2.6 dBm and at 0.15 m (the closest allowed distance due to keep out zone) the received power can be as high as 13 dBm. We do not believe that 6 inches is even possible due to the method of translation around the antenna and the orientation of the suit during translation. The 0.5 meters is probably the closest realistic distance.